COMPRESSED AIR MAGAZINE

DEVOTED TO THE USEFUL APPLICATIONS OF COMPRESSED AIR

Vol. xx JANUARY, 1915 No 1

IN ALL SHAPES.
EVERY SIZE IN STOCK.

Holds All Records.
Best in the World.

HOLLOW and SOLID

"BULLDOG"
TRADE MARK
REG. U. S. PAT. OFF., 1911

ROCK DRILL STEEL

Every bar bears the BULLDOG Brand. None other genuine.

SOLD ONLY BY THE
International High Speed Steel Co.
478 Pearl Street New York City

OVER 15,000 COPIES THIS ISSUE

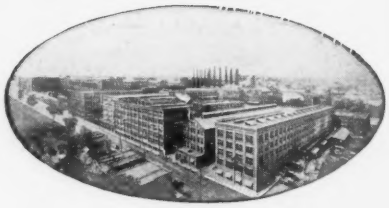
Published by THE COMPRESSED AIR MAGAZINE CO., Easton, Pa.
NEW YORK, Bowling Green Building LONDON, 165 Queen Victoria Street

Classified Buyers' Guide, Pages 14 and 16. Index to Advertisers, Page 8.

GOODRICH HOSE

AIR DRILL
PNEUMATIC
STEAM
SUCTION

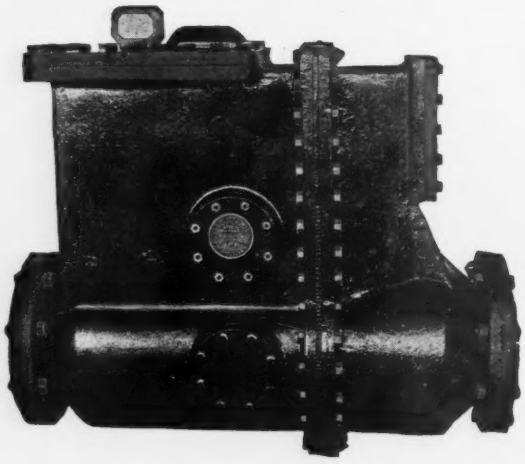
Valves for all Purposes
Goodrich Quality.
Goodrich Service.
Goodrich Experience Profit by them.



The World's Largest Rubber Factory

The B. F. GOODRICH CO., Akron, Ohio

The Westcott Air Meter



A Displacement Meter with readings given in cubic feet of Compressed Air.

You read this Meter the way you read your watch.

Accurate measurement range from 1 to 2 per cent. up to full rated capacity.

Not affected by external jar or vibration.

Made in capacities for small departments or large factories.

Write for Bulletins, Etc.

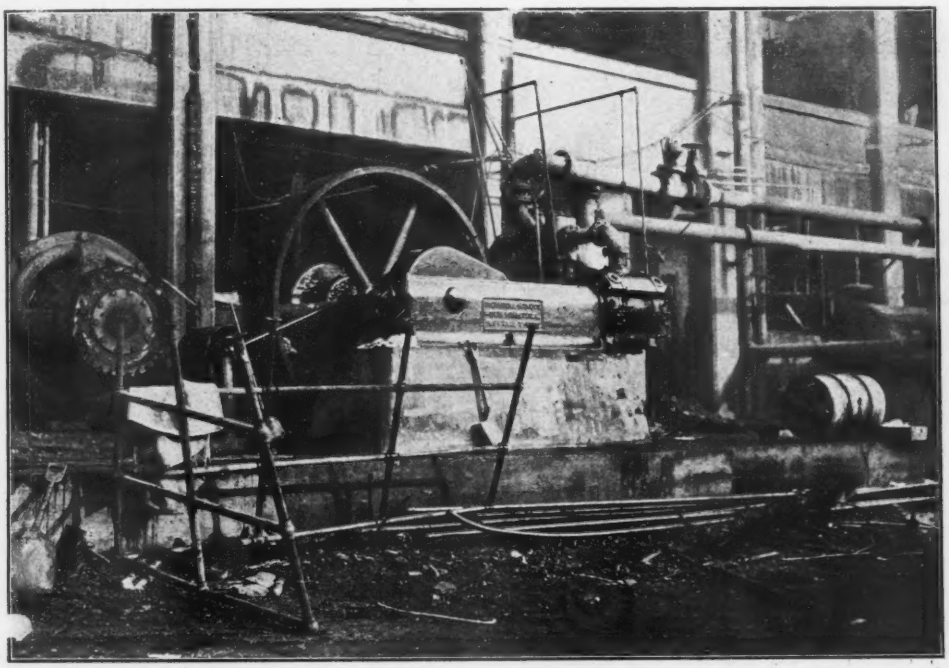
Metric Metal Works Established 1888 Erie, Pa.

Manufacturers of Gas Meters For Any Service.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

Vol XX JANUARY, 1915 No. 1



AIR COMPRESSOR AFTER THE EDISON FIRE.

A SPECIAL AIR COMPRESSOR IN THE EDISON FIRE

The photo here presented constitutes an unusually interesting souvenir of the fire which recently destroyed the works of the Edison Company (Thomas A. Edison, Inc.), at Orange, N. J. Although the destruction of the works was quite complete and the heat of the fire intense, as evidenced by the complete wreckage of the electric motor which drove the compressor—note the condition of the motor pulley—the compressor was scarcely injured at all.

This machine was installed in the Edison works less than two years ago, and it performed an important function in the manufacture of the Edison phonograph record cylinders. For such work as this it might have been expected that the machine would be required to be specially adapted to satisfy the peculiar conditions of working; and such was the fact.

The machine is an Imperial, belt driven (short belt drive) duplex, single-stage compressor with air cylinders 15 inches diameter by 16 inches stroke, and technically designated by the builders, the Ingersoll-Rand Company, as 15-in.x16-in., Type XB-I.

301801

The intake of the compressor, however, was not from the atmosphere, as is indicated at once by the two large pipes leading off to the right from the compressing cylinders. The actual working pressure required in this case was about 95 lb. gage, and all the work was done with a fall of pressure of only about 10 lb., the air at the surviving pressure being connected back to the machine, and it therefore was only required to re-compress the air from 80 lb. to 100 lb., and so allow it to be used over and over again.

This arrangement suggested high economy to begin with, since to have continually compressed fresh air from the atmosphere, delivering it at 100 lb., would have required a compressor of five or six times the volumetric capacity, with two stage compression, intercooling and all that, with more than a proportional aggregate of power consumption. The using of the same air continuously also gave control of its condition as to humidity and temperature, which in this case was of great importance.

The imperative problem of controlling the volume of the compression under the varying conditions of the service, and with the motor running at constant speed was one of unusual complexity, but which was satisfactorily solved by the compressor builders. The air as compressed could not be used at a perfectly uniform rate, nor could it be returned with constant flow, the fluctuations of the two also not being always coincident. The arrangement adopted, which cannot be described in detail here, comprised an automatic unloader at the discharge with a run-around or by-pass to the intake. On account of the high pressure at the intake the cylinder and appurtenances were required to be stronger than for free air service. It will be seen that in various ways this is no ordinary compressor. Mr. Edison has set many inventive and constructive tasks for others besides those which he has set himself to solve.

Franklin S. Lane, Secretary of the Interior, estimates that over $10,000,000 worth of natural gas has been conserved the past year at an expenditure of but about $10,000. For the coming year an effort will be made to save $150,000,000 worth of gas and oil by an appropriation of $25,000.

THE ELECTRIC-AIR COAL MINE

BY CHARLES C. PHELPS.

Reviewing the history of coal mining from the time when mechanical methods of mining began to supersede hand work, we find that for a long time machinery operated by compressed air practically monopolized the field. In recent years, however, with electric energy at hand in many mines for such purposes as lighting, ventilating, pumping, hauling and hoisting, it was only natural that the attempt should have been made to design coal-cutting machinery to be driven by the same power.

Comparing electrically and pneumatically operated coal-cutting machinery, considerations of safety are on the side of the pneumatic machines. Electric feeder wires leading to a cutting machine are an ever-present source of danger to the workmen, especially in view of the darkness and cramped positions in which the miners often have to work.

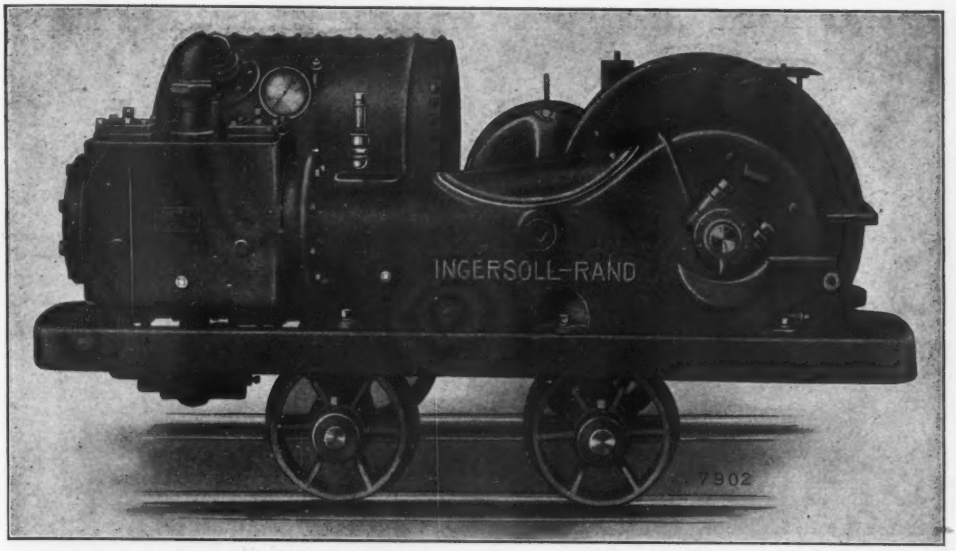
The danger of igniting mine gases is probably greatest near the freshly opened faces for two reasons: First, because of the insufficient ventilation often found in such locations, and second, due to the fact that the opening cuts frequently liberate pockets of gas. Pneumatic machines tend to eliminate the hazard from gas at the face by the added ventilation furnished by the exhaust air.

It is a well known fact that no type of machinery excels air-operated coal-mining machines in ruggedness of design and general reliability. The nature of the pneumatic action insures a cushioned blow which protects the machine to a large extent against injury. The pneumatic mechanism is simpler than the electrical, and consequently is better suited for rough and ready use in coal mines where operating conditions are never too favorable.

In order to utilize and secure the advantages of air power in mines already electrically equipped, additional air lines and compressors have to be provided. At present those mines which are using electrical mining machinery have found it profitable or expedient to do without the inherent advantages of pneumatic methods in order to secure those other advantages which can be obtained from the electrical power. It must be confessed that this procedure is a compromise rather than a solution.

A PRACTICAL SOLUTION FOR THE ELECTRIC MINE

The logical course to pursue in the electri-



MINE TRACK COMPRESSOR.

cally equipped coal mine is to find a means of securing the benefits of compressed-air machinery while at the same time utilizing all of the advantages of the electric system of distribution. This end is best attained by installing electrically operated air compressors in convenient places in various parts of the mine What is a convenient location today will become an inconvenient one in a week or a month, as the mining progresses from room to room. Consequently in an ideal system of power conversion for a coal mine, these local air plants should be portable units.

As a result of these conditions, which are peculiar to the electrified coal mine, operators have been calling for a practical electrically operated portable compressor plant. This demand has been met, and in Fig. 1 is illustrated an efficient compressor of this type.

The truck is built for any gage of track and can be run into any entry that will accommodate a mine car. The compressor may be placed in any convenient location in one of the main entries and connected to the cutting machines in one or more rooms by means of suitable hose.

These portable outfits are designed in every way to meet mine conditions. They are built for either direct or alternating current, and for any of the voltages commonly employed in coal mines. The compressor is suitable for pressures of from 50 to 100 lb., as desired.

The herringbone-gear drive is completely inclosed and runs in a bath of oil. The compressor proper is also of inclosed construction, and has a hopper type of water jacket, which is open to the atmosphere at the top. This type of jacket requires refilling but once a day, which is an advantage in a coal mine, where clean water is usually scarce and where the best attention is not to be expected. The latter idea was kept in mind in adopting the various features of design.

The lubrication is automatic. An inlet unloader maintains a constant air pressure in the receiver, which is mounted on the truck beside the compressor. The valves are of the new Ingersoll-Rogler type, which is a complete departure from previous compressor practice. These valves combine lightness, toughness, small spring tension and large free area, from which follow a high efficiency, great durability and remarkable quietness of operation.

An additional element of economy with the portable type of compressor is found in the fact that the air is used in its heated condition, obtaining the advantages of a reheater without actually employing this device. Of course, the full benefit of this heat is obtained only when using short air-feed lines, as the chilling of the air in passing through a long pipe is rapid.

RADIALAXE WORKING IN A COAL BAND.

THE ECONOMY OF THE EQUIPMENT

One of the first questions that the mine operator will ask is: "Are these portable outfits economical?"

Taking the case of a coal mine already equipped with electricity and desiring to operate a given number of pneumatic coal-mining machines, and comparing the two methods of air supply; i. e., from a motor-driven central air plant on the surface and from a number of small portable air compressors underground, the actual power consumption would undoubtedly be but little greater with the latter system, provided it were properly planned, assuming that both systems employed modern and efficient equipment.

The reasons for this are apparent. Although the motor and compressor efficiencies of the central plant would be higher than the combined efficiency of several small units, it must be borne in mind that the recent improvements embodied in the latter have given them a very fair efficiency. This difference in efficiency is largely compensated by the smaller leakage losses, lower pressure drops and reduced heat dissipation in transmitting the air over the shorter distances to the cutting machines.

It must be emphasized that the above discussion applies only to mines already equipped with electrical power. Of course, these portable equipments would not be advocated for use in a mine not electrified, for it would undoubtedly be much more economical to compress the air in a steam-driven compressor, using slack coal as fuel, and pipe it throughout the mine rather than to construct an electric plant exclusively for driving such portable units.

Other advantages of the portable type of air compressor for the electrified mine are the facility with which the machine may be moved about from place to place in minimum of time,

DRIVING GANGWAY
WITH INGERSOLL RAND CO BCR-4H 3 JACKHAMMER DRILL
STANTON VEIN HOLLENBACK COLLIERY
LEHIGH & WILKES-BARRE COAL CO

GANGWAY DRIVING WITH JACKHAMER DRILL.

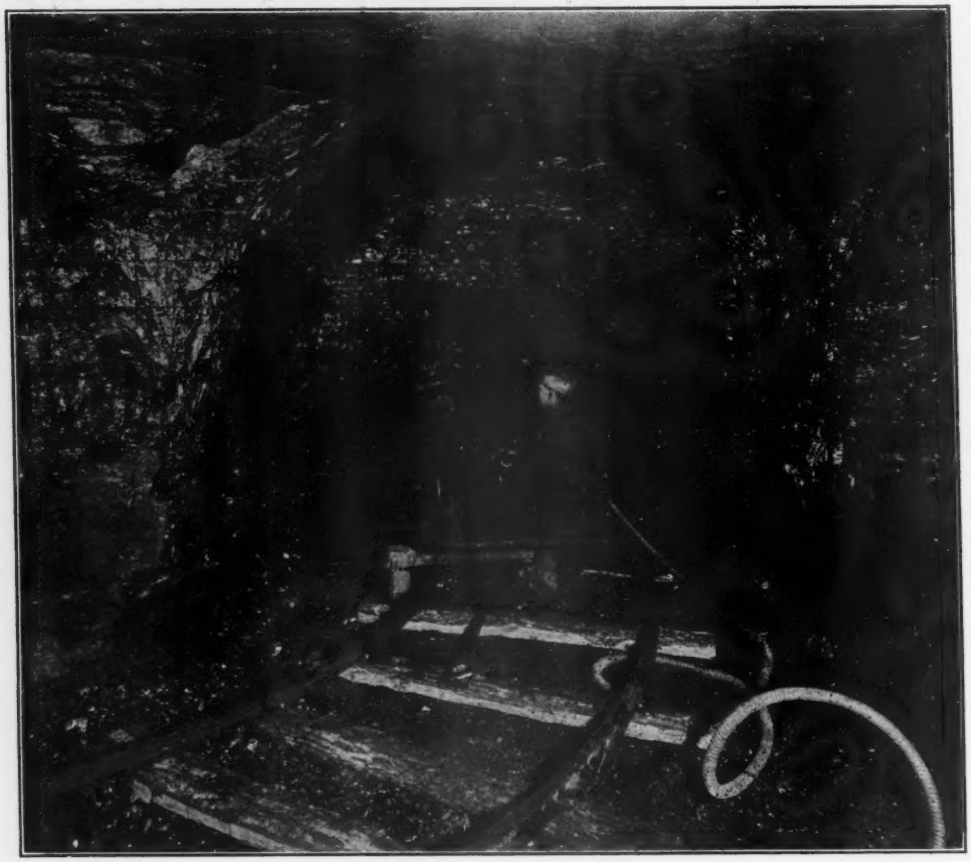
permitting air to be supplied to any room where needed without delay. Moreover, these equipments may be purchased only as needed, there being no necessity for maintaining a capacity in excess of the actual needs of the operation.

Now comes the question of the work capacity of these portable outfits. The following table gives the essential details concerning the various sizes of portable mine compressors already in use, as well as an approximate idea of the number of pneumatic coal-mining machines of different types that they will operate. The power cost will, as a matter of fact, figure out more favorably in actual practice in view of the fact that the service will always be intermittent rather than continuous.

An approximate idea of the capacity of these

PRINCIPAL DIMENSIONS OF PORTABLE MINE CAR ELECTRICALLY DRIVEN COMPRESSORS

Size of Cylinder, In.			Piston Displacement, Cu.Ft.	Air Pressure, Lb. per	Brake	Dimensions		Height over Rails (Width 10-In.
Dia.	Stroke	R.p.M.	per Min.	Sq.In.	Horsepower	Length	Width	Wheels)
7	6	300	78	90–100	12–12.5	7′	4′ 0″	3′ 2″
8	6	300	102	50–60	12–18	7′	4′ 0″	3′ 2″
9	8	250	145	90–100	23–24	8′ 3″	4′ 8″	3′ 10″
10	8	250	179	50–60	22.5–24.5	8′ 3″	4′ 8″	3′ 10″
12	10	235	304	90–100	51–53	9′ 4″	5′ 8″	4′ 4″
14	10	235	415	50–60	52–56	9′ 4″	5′ 8″	4′ 4″



COAL PUNCHER IN ILLINOIS MINE.

plants may be gained from the fact that the larger sizes can operate 3 coal punchers or 1 "radialaxe" machine, 6 to 8 jackhamers or from 8 to 12 "crown" coal picks.

The medium sizes will take care of one coal puncher, 2 to 4 jackhamers and 3 to 6 "crown" coal picks. The smaller sizes will furnish air to 1 or 2 jackhamers or 2 or 3 "crown" coal picks.—*Coal Age.*

In its natural state wood contains no sugar, but when sawdust has been subjected in close retorts to digestion with a weak sulphurous acid solution under pressure of six to seven atmospheres, a very remarkable transmutation takes place, as much as 25 per cent. of the material being converted into sugar. In this there is a valuable feeding stuff for horses, cattle and sheep.

Numerous advantages over pipes of other materials are claimed for the asphalt-paper pipes that are being introduced in Austria. The makers assert they can replace iron, steel, copper and clay piping for all purposes except the conveyance of hot fluids, concentrated acids, and petroleum. The pipes are made from a special kind of asphalt paper of German manufacture.

The Yale "Bowl" has a playing arena 300 by 500 feet, outside dimensions 750 by 950 feet, a seating capacity of 61,000 and no standing room. The dimensions of the Colosseum at Rome were: arena, 177 by 281 feet, seating capacity, 50,000. The dimensions of the structure at Pompeii, which the Bowl most nearly resembles, were, 115 by 218 feet and 342 by 444 feet, seating capacity, 20,000.

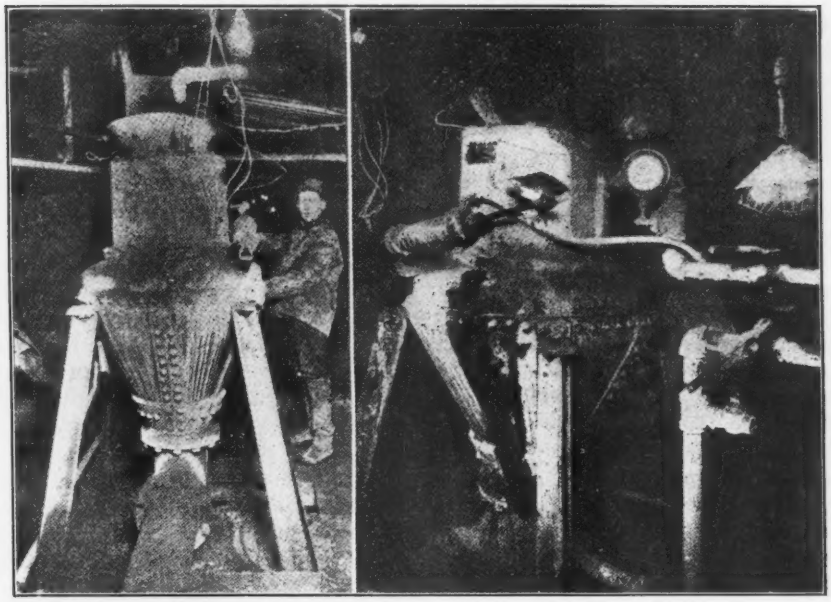


FIG. 1.

RECORDS OF OPERATION IN HANDLING CONCRETE WITH COMPRESSED AIR

The following is an abstract of a considerably longer article in a recent issue of Concrete-Cement Age. The topic treated is not new, but the details of operations are interesting and valuable. The information embodied was furnished by H. B. Kirkland, President of the Concrete Mixing and Placing Company, Chicago.

At present there are a great number of plants, working at different localities all over the country, successfully placing concrete through pipes with compressed air. This method is now well established on a commercial basis, there having been in operation for the last three years machines which handle aggregate of large size and mix and place concrete at the rate of from 15 cu. yds. to 40 cu. yds. per hr.

The use of a pipe line takes the place of all the men used to haul, hoist and transport concrete, and eliminates the necessity of such plant as towers, runways, dinkey engines, track, trestle, cars and other plant ordinarily required for conveying concrete.

Tests on concrete made in this manner show results that are at least as high as concrete made in the ordinary manner.

DESCRIPTION OF PNEUMATIC MIXER AND CONVEYER.

The mixer, shown in Fig. 1, consists essentially of an inverted boiler plate cone, standing vertically, having an air-tight door at the top for the admission of materials, with a cast steel elbow at the bottom through which the concrete is discharged to the conveyer pipe. The door is operated by a small pneumatic piston, and nozzles are provided for the admission of air into the top of the cone and into the elbow at the bottom of the mixer.

An 8-in. pipe of No. 10-ga. metal or an 8-in. well casing is ordinarily used for conveying the concrete. A heavy steel pipe may be economical where large quantities of concrete are to be placed without any changes in moving of the pipe line. The facility with which the delivery pipe can be carried under, over, or around obstructions which would make wheeling difficult is one of the important advantages of the system.

METHOD OF OPERATION.

The operation of the mixer is very simple. The sand, stone, cement and water in the proper proportions are fed into the mixer through the hopper and the door is closed by the small air cylinder shown. The compressed air is then turned on, entering the mixer at

two points, one above the charge, and one at the heel of the elbow. The batch is forced through the pipe to the forms, it being mixed as it leaves the mixer and in the first few feet of pipe. The concrete is thus mixed with the same air which is used to convey it through the pipe. In this way the concrete is mixed and placed without labor and with no other equipment than pipe for transporting the concrete. Within 10 sec. after water has been added to the cement, the concrete is in the forms at rest. It is all done in one operation.

The amount of air required for operating the machine depends upon the length of the delivery pipe. This will vary also with the number of turns in the pipe line, with the kind of material used for aggregate and with the vertical distance involved in the delivery. It is demonstrated, however, that for general purposes of calculation, the amount of air will not exceed 1 cu. ft. of free air compressed to 80 lbs. pressure for each lin. ft. of 8-in. delivery pipe for each batch of concrete.

An air storage tank is usually placed close to the machine, the capacity of this tank being large enough to store sufficient air at 80 lbs. pressure to discharge one load, which means 1 cu. ft. of space for each 6′ of pipe line. For general concreting work a compressor of 600 cu. ft. per min. capacity is said to be the best size, although a 300-cu. ft. machine would be large enough to use with a ¼-yd. mixer and 300 ft. of pipe.

When the proper size of stone is used, there is little likelihood of clogging occurring, provided the machine is not operated with an air pressure very much below the 80 lbs. required for successfully carrying the concrete to the full distance.

Wherever it is desirable, a box may be used to receive the concrete as it is discharged from the pipe, from which it can be allowed to run out by gravity into the forms.

OUTPUT OF MACHINE.

The output of the machine is dependent upon the speed of loading. The mixers are made in ¼-yd. and ½-yd. sizes and the speed of loading varies between 60 batches and 120 batches per hr. The provision of overhead bins makes possible the higher rates of loading which would give the ¼-yd. machine a capacity of 30 cu. yds. per hr., and the ½-yd. machine 60 cu. yds.

APPLICATION IN GENERAL.

Work in which the pneumatic method had already been used to advantage comprises bridge construction, tunnel lining, retaining wall construction, heavy foundations and piers, as it is not required that the mixer be located above the point of deposit as is usually the case with plants distributing by gravity systems. That is to say, the concrete plant can be located lower than the place of deposit and the pipe can be run along the line of the work at any level with vertical pipes placed to raise the material to the points of deposit. This puts the concreting equipment entirely out of the way of the other construction plant and makes it possible to do concrete work without monopolizing the cableway or the derricks.

FOR LINING TUNNELS.

The machine is well adapted to tunnel lining, as it enables the arch to be placed as rapidly as the side walls. Sections of tunnel 25 to 40 ft. in length may be filled by entering the pipe through the form at the top, or in large tunnels at both top and haunches.

In small tunnels where the shafts are great distances apart the machine is taken into the tunnel and sunk, by blasting out a place for it, so that the top of the machine is low enough for the narrow gage cars to dump into it. In this way a tunnel of any length may be concreted by using pipe about 500 ft. long and moving the machine back for each 500 ft. section.

CAR FOR LINING LARGE RAILROAD TUNNELS.

Figs. 2 and 3 give an idea of the equipment used by the C. B. and Q. R. R. for lining the 1000 ft. Alkali Summit tunnel, where the concrete has to be placed without disturbing the traffic. The pneumatic mixer and conveyer, previously described, is mounted on a standard 40 ft. flat car, with material bins, cement storage, a water tank and a delivering pipe leading from the mixer out above the car. Both bins slope toward the mixer placed in the center of the car, where they discharge through chutes into a measuring hopper.

This hopper is lifted and tilted to discharge into the mixer by means of a cable operated by a small air cylinder. Air to operate this cylinder and to supply a large receiver operating the mixer is obtained from the compressed air main laid on the track the full length of the tunnel, connection being made to the car at any point. Water also is sup-

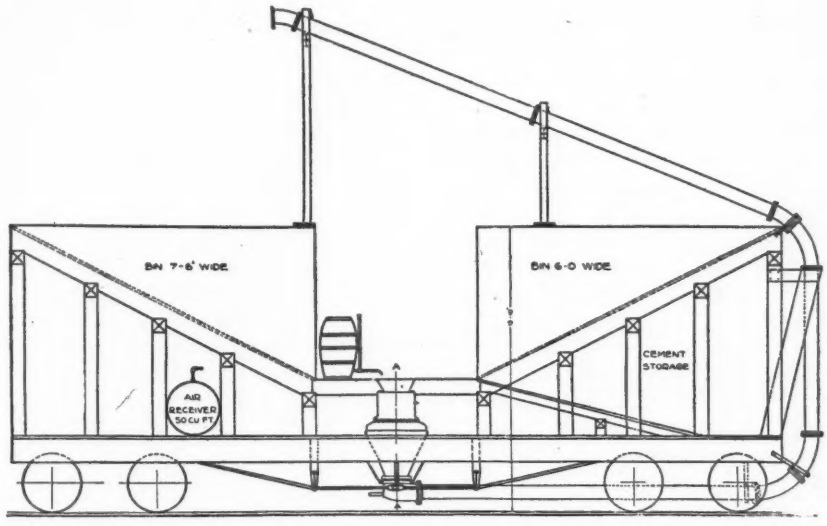


FIG. 2.

plied from a line paralleling the air line. The bins, holding material enough for 25 cu. yd. of concrete, are loaded and the car is run into the tunnel and connected to the air line.

The 8-in. pipe which conveys the concrete from the mixer to the tunnel forms, runs from the mixer under the car, up at the end to the top of the bins, 14 ft. above the rail, and thence on an incline to a point 24 ft. above the rail, where it enters through a bulkhead of the tunnel form, a slot being left to shift the end of the pipe slightly, depending upon which wall of the tunnel it is desired to fill. This inclined pipe is raised and lowered between wooden guides by a cable attached to an air-cylinder. The guides may then be folded down out of the way, giving 16 ft. of head room for braces. Fig. 3 shows an end view of the car with the conveying pipe folded down so that the car can be moved.

The mixing and placing of 25 cu. yd. of concrete takes 1 hr., and the operating crew consists of four men: One who operates the mixer and all the valves, one to carry cement, one to untie the cement bags and dump the cement into the hopper and one to operate the gates for filling the measuring hopper with aggregate. The air pressure used to operate the mixer and conveyor is 80 lb. For retaining wall work the pipe is usually carried from the mixer up over the top of the forms with a right angle at the end for discharging directly down into the forms.

VARIOUS TYPICAL JOBS.

One of the first tunnels upon which this machine was used was the La Salle St. tunnel, Chicago, where the machine was set up on the bank of the river and the pipe extended from the machine down a shaft 35 ft. deep and

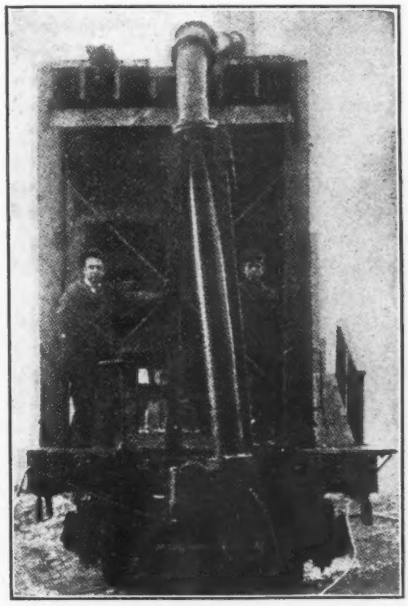


FIG. 3.

then horizontally about 300 ft. Later, on the O. K. Creek sewer tunnel, Kansas City, the machine was placed at the bottom of the shaft and the materials for the concrete were dumped into the machine through a chute from the top of the shaft.

The Otis Steel Company recently used a ¼-yd. machine at Cleveland, for placing the piers for its new plant. [This was described and illustrated in Compressed Air Magazine, June, 1914.] There were about 300 piers of various heights, the materials totaling about 25,000 cu. yd. The machine was located at one side of the lot with its top flush with the ground and a bin with a capacity of 80 cu. yd. of crushed slag and 30 cu. yd. of sand was built over it. Ample means for conveying and distributing without hand work were provided. The necessary air at 80 lb. was furnished by an Ingersoll-Rand electric driven compressor. The average daily speed was one batch per min., or 15 cu. yd. per hour.

On outside mass concrete construction the work at the Ontario Power Company's plant, Niagara Falls, Ontario, Sept., 1913, illustrates a great economy. On a portion of this work there were three separate retaining walls, one 20 ft. below the level of the mixer and about 100 ft. to the east. The two other walls were at an elevation of 30 feet above the mixer and 80 ft. to the east. The plant required one foreman and 10 laborers to charge the mixer; three men to operate it and one foreman and four men to spread the concrete in the forms. During the time required to change the pipe, the charging gang was used in excavating, so that a portion of their time was not chargeable to the cost of placing the concrete. The labor cost per hr. was $4.80, and, charging the actual time used in placing 257 cu. yds., the cost amounted to $77.35, or 30 cents per cu. yd.

One of the most important jobs yet undertaken under this system is the lining of St. Louis waterworks tunnel. This tunnel is 8 ft. in diameter with a concrete lining 9 in. to 18 in. thick; it is not reinforced and is located in solid limestone. The tunnel is about 2,900 ft. long and has a shaft on the bank of the Mississippi river, which is about 550 ft. from the west end of the tunnel and about 2,200 ft. from the east end, which is under the Mississippi. The land section of the tunnel was concreted first and the concreting was practically all done in the month of May, 1914, doing but two arch sections, 36 ft. each, in April. The grade of the tunnel from the shaft west is + 6 per cent.

The mixer was set at the bottom of the shaft, which is 96 ft. deep, and was loaded from the top by dropping the material for each batch through an 8-in. pipe directly into the mixer. At the top the batch was measured by means of a measuring hopper in which the batch was placed. At a signal from the machine operator below, the sliding door of the hopper was opened, which allowed the batch to drop into the mixer through the pipe. Water was dropped at the same time through a 2-in. pipe which led to the mixer and which was supplied from a water barrel controlled by the man operating the hopper gate.

As soon as the batch was dropped into the mixer the operator closed the door into the machine which was operated by a small air valve and turned on the air which mixed and discharged the concrete through an 8-in. pipe into the forms.

The forms are 36 ft. in length and the pipe carrying the concrete is laid along the bottom of the tunnel to within 20 ft. below the forms and then by means of two 22½ degree elbows and one section of pipe 20 ft. long, the pipe enters through the top of the forms through a bulkhead. The section of pipe 18 ft. to 20 ft. long is put over the top of a 36-ft. form and the concrete is discharged through this until half of the form is poured. The concrete is discharged back against the completed concrete work and flows around the form, assuming the slope of about 30 degrees. When the arch is filled to within 1 ft. or so of the end of the pipe the end piece of pipe is removed so that the balance of the form is filled by discharging concrete from the end of the pipe just entering through the bulkhead.

Sand bags are employed for bulkheads instead of employing carpenters constantly to patch up the irregular places. The bulkhead, which consists of a 9 in. board bolted to the center and sand bags, is laid against the board projecting beyond the board into the irregularities of the rock. While the concrete work is going on the bags are laid by a man who watches the progress of the concreting. He can see under the forms and determine whether or not the concrete is filling equally on both sides of the form and if it is not he can spring the pipe over to one side or the other

to keep the load balanced. The concrete is usually brought to within 1 ft. of the end of the pipe and then if desired this small pocket may be filled by discharging a very small batch through the mixer, or it may be filled by hand in case the last batch has spilled enough concrete over. The usual practice, however, is to leave the concrete about 1 ft. from the pipe and to move the forms just sufficiently to take in this cavity in the next pouring.

The Fruin-Colnon Contracting Co., St. Louis, is the general contractor on the construction of the new tunnel and the intake tower.

THE NEWEST ROCK DRILLING PRACTICE

The following we take from an elaborate article by Mr. F. Lavis, in *Engineering News*, Dec. 3, 1914, describing construction operations on the New York Rapid Transit extensions.

One feature of considerable interest, is the quite extensive use of the so called Jap or hand hammer drill with hollow drill steel. The New York rock, a soft to medium hard gneiss or mica schist, seems to lend itself particularly well to the operation of this kind of drill in excavations where most of the holes are down holes. The type which is in most general use, is the Ingersoll-Rand B.C.R. 33, which weighs about 90 lb., using air at 80 to 90 lb. pressure. The hollow drill steel is usually about 1⅛ in. octagon, the holes are drilled dry, the air through the steel blowing out most of the dust, therefore keeping the holes clean and consequently increasing the effectiveness of the machines. These drills are used for drilling holes to depths up to 12 and 14 ft.; it is stated that they require from 50 to 75% less air at the same pressure than the usual tripod drill does, and only one man is required to operate each of them. The general opinion seems to be that unskilled laborers with very little instruction could use these drills, though, of course, in New York the labor unions compel the employment of regular union drill runners.

On Section 14 (McMullen & Hoff) four men with as many drills were averaging from 80 to 90 ft. of hole per man per day of eight hours. There was one record of 113 ft. for one man in eight hours. It was considered advisable to keep a number of spare drills on hand, so that in case anything went wrong, there was no delay, and any damaged drill could be taken to the shops, where it could be carefully repaired by a competent machinist, even though the trouble was very slight. This was considered to be better than to have an ordinary drill runner try to fix it with the spanner or sledge hammer, the tools usually used by them when anything is wrong with a drill. These drills were also used on the heavy rock excavation of Section 13, a cut 30 to 50 ft. wide and as many feet deep, with excellent results.

On some sections a lighter type of drill weighing about 40 lb. and using about 50 ft. of air per min. is being used; this is the B.C.R. No. 430 or so called Jackhamer type, used for holes up to 6 and 8 ft. in depth using ⅞-in. hollow steel.

Another point of interest is the almost universal use of machine drill sharpeners, nearly all of which are of the Leyner type. This use of machine sharpeners is possibly due, to some extent, to the use of the hollow steel and the rose-shape form of bit generaly used with these hand drills, though of course, it has been shown even with the old type of cross bit, that where the number of drills warranted, the installation of a drill sharpener was an economy.

It is stated by the contractors on Sec. 13 and 14 that the general breakage and wastage of steel used is rather greater than with the ordinary steel, and, of course, the hollow steel is more expensive, but it is thought this is much more than compensated by the greater amount of work done. The Leyner drill sharpeners are used to make all the bolts for the timbering on one section, where it was stated that 400 bolts were headed per hour.

Electric current is used for power at most of the compressor plants, and air is usually piped to all points of the work for use in drills, pneumatic riveters, etc. In some cases the air is used for operating hoists and derricks, in other cases electric power is used directly for this purpose; this apparently is governed most generally by the plant the contractor may have had on hand, but the use of air for hoists and derricks, so long as it has to be installed in any event, seems to be the most satisfactory and most generally used.

REHEATING COMPRESSED AIR

Various schemes for heating the air during

cold weather were noted, some of the apparatus home-made and other manufactured especially for the purpose. On one section (McMullen, Snare & Triest) an upright coil of about 6 to 8 rings, 15 to 18 inches in diameter, was made in the air line near the point where it was to be used, and a fire built and maintained inside the coil. In another case a piece of 6- or 8-in. pipe about 3 ft. long was capped at the ends to take the regular air line (about 2 in.) and a fire built under the larger section. These home-made schemes are probably somewhat wasteful of fuel, but this amounts to very little and they probably stand up better under the rough usage they get on this kind of work, than the manufactued heaters.

RECORD OF ELECTRIC-AIR DRILLS ON THE MESABI RANGE

For five months, during 1913-14, some interesting drilling was done at the Virginia mine on the Mesabi range, under the direction of J. H. Eby, at that time superintendent. The machines used were Type 5-F Temple-Ingersoll drills, on tripods. It may be well to recall here that these drills employ both air and electricity in their operation, but not in the manner of some other electric air drills. The air is not used once and exhausted, but constitutes the manner of transmitting the electric power. The air circuit is a closed one, the air being returned for use again, excepting that small portion that escapes through leakage. The drill is connected to a separate carriage, holding the pulsator and motor, by two lines of air hose, acting as the supply and return lines.

At the Virginia mine the drills were operated on a 220-volt three-phase alternating current. They were manned by a runner, at $3 per day, and two helpers at $2.40 per day each. All the holes drilled were over 10 ft. deep and the majority over 24 ft. deep. Some of the holes were vertical and some were as flat as 5 degrees from the horizontal. Incidentally, according to Mr. Eby, experience proved that cruciform steel was best adapted to the work, the great difficulty being in keeping the holes clear of sludge. The material drilled varied from soft hematite to extremely hard taconite. In the latter rock, three hand drillers, two striking and one turning, with an ample supply of sharp steel could drill not over 1 ft. per hr. Fissured ground was common, and the ore was exceedingly irregular, with hard seams in the soft ore. The softest ground was the most difficult to drill because of fissuring and caving.

The following tables show the data obtained from five months' operation:

TABLE 1—HOLES DRILLED

Number	848
	Feet
Solid taconite	826
Fissured taconite	402
Hard ore, solid	2346
Hard ore, fissured	518
Soft ore, solid	3875
Soft ore, fissured	1130
Total	9097

TABLE 2—TIME DRILLING

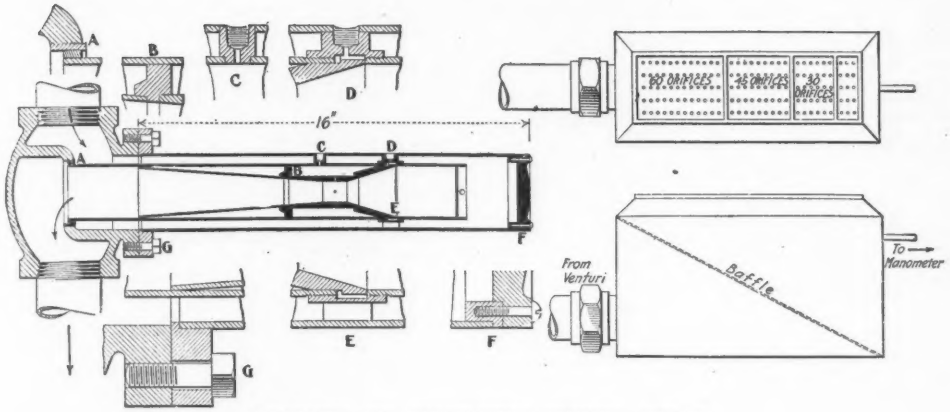
	Hours
Machines in place	1465
Delays, long moves	39
Power off	140½
Dull steel	11½
Bad order of machines	56
Net working time	1218

TABLE 3—COSTS

Labor	$1183.75
Repairs	25.00
Power	68.10
Total	$1276.83

Cost per foot, 14c.

The cost of drilling the same footage by hand on company account would have been 29c. per ft. This figure was obtained from four years' costs of the same class of work and covering the same amount of each class of material, but not taking into account the flat holes that could not be drilled by hand. These costs indicate a saving of 15c. per ft. by the use of this drill. Mr. Eby makes the interesting statement that it requires as much skill, if not a little more, to operate and properly handle this drill as it does any other. The costs given above include all the troubles incident to securing competent crews to handle the machines, and he believes that if operated regularly as efficiently as these were during the last month of work, the cost per foot could be reduced still further, perhaps to as low as 11 cents.—*Eng. and Min. Journal.*



APPARATUS FOR CALIBRATING VENTURI METERS.

CALIBRATING VENTURI METERS FOR AIR FLOW

In the design of the Brooklyn Sewage Experiment Station under Geo. T. Hammond, Engineer of Sewer Design, Bureau of Sewers, Brooklyn, N. Y., one of the troublesome problems was in securing a meter for the compressed-air lines. On account of the quantity of air used and the pressure, no form of available gas meter was found to meet the requirements. Therefore, special Venturi meters were designed jointly by Mr. Hammond and Wallace & Tiernan, of New York City. Interest attaches first to the method of calibration, and only somewhat less to the details of the meters.

CALIBRATION

The calibration method is of unusual interest and wide application. On account of the quantity of air flowing, it was impractical to use a gasometer for calibrating the meter. Therefore, a special multiple-orifice box was built to receive and measure the air passing through the meter. The top of the box was a metal plate having, in all, 150 orifices of the same size (made with the same punch) equally spaced. This top plate had a cover so arranged that any number of orifices from 1 to 150 might be left open. The orifices were designed to discharge 1 cu. ft. per min., under a head of 10 in. water pressure. A perforated metal screen, placed diagonally across the box, prevented eddy currents. Preliminary readings were made with a small gasometer to determine the air flows from different orifices (for rating the calibration box) and from different groups of orifices to see if there was any variation because of location or number of those discharging. It was found that the flows agreed within ½%.

In calibrating a meter, the box was connected to the air line through the meter and a certain number of orifices were uncovered on the top of the box, a stop valve being opened until the desired head was shown on the box manometer. Knowing the discharge for this number of orifices and the corresponding pressure, it was a simple matter to mark on the Venturi-manometer scale the flow corresponding to the height of liquid. The scale was then fully graduated in cubic feet per minute after having determined several of these points.

VENTURI METERS

The specifications, according to which the Venturis were made, called for three sets of meters; one reading from 20 to 150 cu. ft. per min., one from 5 to 20 cu. ft., and a third from 1 to 30—all operating under a pressure of about 40 lb. per sq. in. In order to secure the desired range with accuracy a type was designed with interchangeable throats. To secure accuracy through the range indicated, five meters would ordinarily be employed. Such multiplicity was ingeniously obviated in this case. The meters were assembled in tubes of the same size so that any one could be screwed into the body of an ordinary 3-in. check valve put in the air line. There were three barrels complete, with Venturi throats, etc., for each meter. Two of these three barrels were of small capacity and each had interchangeable throats, while the third was larger and had but one throat.

Air passes from the check valve (following

the arrow in the upper left of the section of the meter shown in the accompanying drawing) along the meter barrel, through the throat and out through the air line again. To put in a larger or smaller throat giving the desired capacity, the barrel cap is removed, the approach tube screwed out of its bushing, and the throat approach and throat taken out. Without displacing further parts, the smaller or larger throat is inserted. All parts were made of brass and bronze.

The manometer intended for use with these Venturis was of special design. The cross-section of the oil reservoir was made many times greater than that of the manometer tube, so that the zero point was practically unaffected through the range of the scale. The upper end of the manometer tube, which was connected to the Venturi throat chamber, had a reservoir interposed of capacity slightly greater than that of the lower reservoir. This was done to prevent blowing any of the oil into the pipe line by sudden rushes of air. It may be added that these meters are used to measure compressed air supplied in experiments on the aëration of sewage.—*Eng. News.*

BEHAVIOR OF EXPLOSIVE MIXTURES OF GAS AND AIR*

An explosion is essentially a very rapid combustion which ocurs almost simultaneously in all parts of a mass of combustible substance. The heat developed by the combustion raises the gaseous products of combustion to a very high temperature, and gives them the enormous pressure and expansive tendency which produce the destructive effects of explosives.

In order that combustion shall be almost instantly propagated throughout a mass of gas it is necessary that the air required for combustion shall be intimately mixed with the combustible gas, and in order to attain the high temperature requisite for explosion the mixture must not contain a large quantity of gas that takes no part in the combustion, for such a mass of inert gas would exert a cooling effect. This consideration leads to the law, which is confirmed by experience, that mixtures of combustible gas with air are explosive only when the percentage of combustible gas in the mixture lies between certain limits. These limits, for some important gases and vapors, are given in the following table:

Gas or Vapor.	Percentage of Gas in Explosive Mixture. Upper Limit.	Lower Limit.
Hydrogen	66.4	9.45
Illuminating gas	19.1	7.9
Methane (marsh gas)..	12.8	6.1
Alcohol vapor	13.65	3.95
Ether vapor	7.7	2.75
Benzine vapor	4.9	2.4

The explosive limits, however, are dependent to some extent upon the size and shape of the containing vessel and upon the character of the ignition (strong electric spark, weak spark, or flame).

It will be observed that the proportion of combustible gas required to form an explosive mixture with air is very small, except in the case of hydrogen. Explosion may be caused by the presence of less than 3 per cent. of ether or benzine vapor in the atmosphere. In general, however, the danger of explosion is proportional to the range of explosiveness, i. e., the difference between the upper and lower explosive limits, and is consequently greatest in the case of hydrogen.

The danger of explosion can obviously be averted by preventing the mingling of the combustible gas with air.

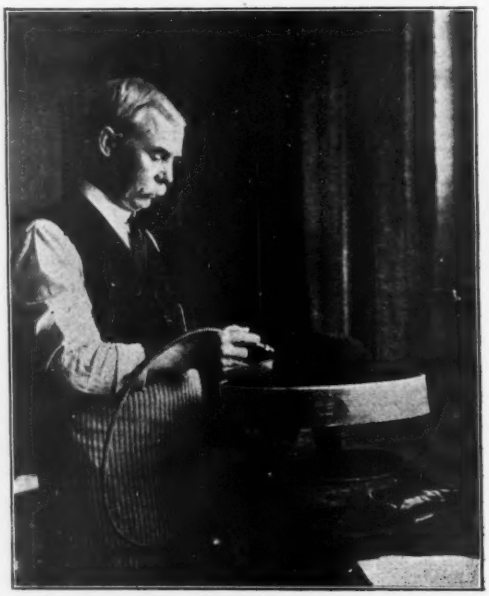


FIG. I.

*Scientific American translation from article by Victor Rodt in *Die Umschan.*

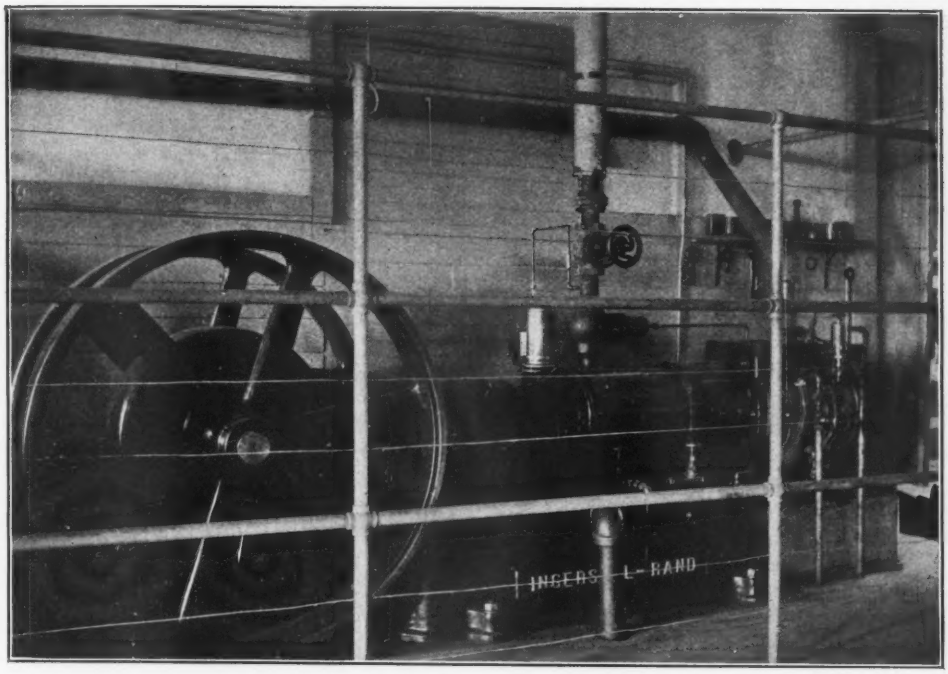


FIG. 2.

BRUSHING VS. BLOWING

BY CHARLES C. PHELPS

Hat makers find air jets superior to brushes for "raising the nap" on certain kinds of material, such as velours, beaver, clip beaver and imitation velours. After the hat has been formed in presses it is "ironed" by passing a hot damp cloth pad over it. The final operation is for the purpose of raising the hairs or fibres and imparting to the hat a fluffy appearance. Formerly brushes were used for this purpose, but they were slower and not so effective as the blowing method. Further, the air jet assists in rapidly driving out any remaining moisture, thus eliminating any danger of matting the fibres when packing the hats for shipment. The hat is rotated on a revolving form while the air jet is directed against it from a distance of a few inches. (Fig. 1).

The commonest form of nozzle used by hat manufacturers has a tip with a flat opening ½ inch in length and 1-16 inch or less in width. There is a self-closing valve close to this nozzle, so that there is no waste of air when the pressure of the thumb is removed from the button which controls the flow.

In the factory in which Figure 1 was photographed a ⅜ inch wire-wound air feed pipe was employed and the pressure maintained in the air line was 80 pounds per square inch. A large number of these jets were employed, in fact the demand for air was much in excess of the rated capacity of the compressor supplying this air, Fig. 2. As a result, the compressor was run under an overload a great part of the time and naturally the valve bonnets, which were the only parts not cooled by the water jacket, became excessively hot. This accounts for the wooden receptacle on top of the air cylinder, on the right hand end of the machine, which was improvised by the engineer to keep the valves cool with the aid of a water bath.

The photographs were taken in the hat factory of Wm. Knowlton & Sons, West Upton, Mass.

The annual meeting of the Compressed Gas Manufacturers' Association, Inc., will take place Monday, January 18, 1915, 2.30 o'clock p. m., at 25 Madison avenue, New York City.

GAS ENGINE HORSEPOWER AT DIFFERENT ALTITUDES

It has been the writer's experience that many students, and in many cases men who have had considerable gas engine experience, have the idea that the power of a gas engine increases as the altitude increases. They figure that at the higher altitudes the engine exhausts against less back pressure, and therefore its power is increased.

Although the engine is exhausting against back pressure, it is this same atmospheric pressure that supplies the engine with its mixture of fuel and air. If the pressure that supplies the cylinder with the mixture is reduced, the compression is reduced because the actual amount of mixture forced into the cylinder is less. As a result, the mean effective pressure is less and, therefore, of course, the actual output is less.

The decrease of power is in direct proportion to the decrease in atmospheric pressure. So if the altitude is known the barometric pressure in inches of mercury or the pressure in pounds per square inch can be obtained. Then a simple calculation will give the horsepower at that altitude. As a formula, it is as follows:

$$H_2 = H_1 \frac{P_2}{P_1}$$

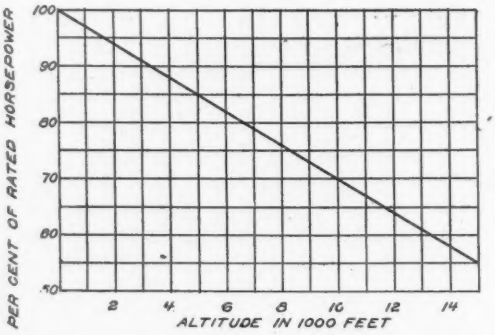
Horsepower at given altitude (H_2)=horsepower at sea level (H_1) times ratio of atmospheric pressure at given altitude (P_2) to atmospheric pressure at sea level (P_1, 14.7 lb. per sq. in., or 29.9 in. of mercury.)

Approximately the atmospheric pressure decreases 0.5 lb. per 1000 ft. elevation. This is close enough to give a good idea what the engine will deliver at the required altitude. The following tables gives the atmospheric pressure at various altitudes up to 2 mi.

Alt., mi.	0	¼	½	¾	1	1¼	1½	2
Atmos. Pres., lb.	14.7	14	13.3	12.7	12	11.4	10.9	9.8

A more rapid and convenient method of calculating the horsepower at various altitudes is by a power curve, such as the one shown. This power curve will give results that are very accurate.

The following problem will serve to illustrate the methods of determining the horsepower. Problem: Required the power a 250-hp. gas engine will develop at an altitude of 1½ mi. above sea level when using the same fuel as that which gives the engine the 250-hp. sea level rating.



GAS ENGINE POWER AT DIFFERENT ALTITUDES.

At an elevation of 1½ mi. the atmospheric pressure is 10.9 lb. per sq. in. Now substituting in the formula:

$$\text{Power} = 250 \times (10.9 \div 14.7) = 185.3 \text{ hp.}$$

An altitude of 1½ mi. is practically 8000 ft. On the diagram, the power curve crosses the 8000 ft. altitude line at practically the 75 per cent. horizontal line. So the engine at 8000 ft. should develop 75 per cent. of its rated sea level power or $0.75 \times 250 = 187.5$ hp.—*Practical Engineer.*

CARE OF DRILL STEELS AN IMPORTANT FACTOR IN MINE EFFICIENCY

The following is an abstract of a portion of an article by Thomas M. Bains, Jr., in Mining and Scientific Press of San Francisco.

In too many mines sufficient attention has not been given to the systematic handling of the drill steel. With adequate steel, properly sharpened and heat treated, a machine man can drill twice the depth of hole that the same man under similar conditions can with too few drills or with plenty of steel which has been subjected to improper heat treatment. The process of sharpening and gaging has been worked out mechanically, by means of drill-sharpening machines.

SUFFICIENT STEEL AT EACH WORKING FACE

The purchase of sufficient steel and turning it over to the blacksmith does not mean that sufficient steel will be at each working face. In cases where contractors and company men work in the same mine, the contractors will 'corner' the steel and the company men will be short. Few mines in this country seem able to get steel to the machine men so that they will

have a sufficient supply. It is generally left for each 'shifter' to secure steel for his shift or else each individual must 'rustle' his own steel.

In one of the largest of the Eastern mines, the steel was lowered down the shaft to the station once each shift. The machine men or helpers waited for it like a pack of wolves. Before the cage was within two feet of the level of the station, a rush like a football scrimmage took place. Men with seven or eight 'starters' would exultantly dash away from the cage, while others secured all long drills. Some would not secure any at all. In one case, two men had a four-foot and two six-foot drills with which to drill a complete round.

RESULT OF A CHANGE OF SYSTEM.

The same conditions hold in Western states. A case similar to the above occurred in one of the large Mother Lode mines of California. The company operating the mine had from 100 to 200 men on its payroll. The mine finally shut down, having a deficit of $90,000 for the year. The company then leased the different levels to some miners who had previously worked for it. Thirty-four lessees produced nearly the tonnage that the average 150 company men had. The lessees in most of the cases made good 'stakes' from the leases. The company had poor steel conditions; not only insufficient steel, but the heat treatment was very poor. The lessees had one of the best men on steel to be found. There are hundreds of cases of this kind in the country, where the cause of loss is due to neglect of the fourth factor alone.

LOSS OF STEEL IN MINES

Before considering the remedy for this state of affairs, the question of the loss of steel in the mine should be considered. This decides the quality of steel in some cases. Managers will often state that they use cheap instead of high-grade steel because the financial loss due to the losing of steel underground is greater than the saving made by the use of high-grade steel. In one mine in California, 600 new drills were sent underground and within six months only 150 were left. By searching the mine thoroughly, about the same number were found hidden or thrown in obscure places. So in six months half of this new steel was lost.

A GOOD WAY TO DISTRIBUTE STEEL

To secure the highest efficiency in drilling, each machine man should have, on arriving at his working place, a complete set of drills, properly sharpened and heat treated. This could be accomplished in many mines by having the mine carpenter build a rack for each working place, or else iron racks could be made in quantities. Each should have two compartments with different locks. The rack should be kept as close to the working face as practicable. When the machine man comes on shift in the morning, he finds his complete set of drills near his work. On finishing his round, he replaces all the drills, dull ones 'bit' upward. The night men also find a complete set of sharp drills in their compartments of the racks. During the night shift, the 'nippers' would take out all the dull steel from the day shift's compartments and return sharp drills later on. The 'day nippers' would handle the night shift's drills. The steel for stoping machines should be near the manways into the stopes. Keys to the racks should be turned in at the end of each shift, and the shift bosses should see that each machine man, on coming on shift, is given a key to his rack. 'Nippers' should have master keys to the compartments holding steel of the *opposite* shift, while shift bosses should have the master keys to the compartments holding steel for *their* shift.

By the use of this system the best quality of steel could be purchased, as the loss from missing steel would be cut down to the minimum.

HEAT TREATMENT OF DRILL STEEL

The heat treatment of drill steel has a more important bearing on drilling efficiency than any other one factor. The effects on drill steel due to improper heat treatment may be classed under the following heads: (1) dulling of the cutting edge of the bit; (2) breaking of the bit, due to 'checking'; (3) loss of gage.

The first entails loss of power due to the crushing of the rock, instead of its being chipped. This means less footage or else necessity for more drills. Breaking of the bit due to imperfect cooling, causing the drill to 'check,' may mean the loss of a hole, decreasing the effective footage drilled. The last effect, however, is the one that causes the greatest losses in efficiency. Drills that lose their gage rapidly may cause loss of holes, due to the fact that the next longer drill will not follow. In attempting to make a bit follow one that has lost its gage, much time and energy is wasted. The psychical effect on the miner

is of great importance also. Often the machine will have to take the punishment, a sledge being used to loosen the bit and sometimes the blows fall on the piston rod or other vulnerable parts of the machine.

The loss of gage is due to the corners of the bits being too hard or soft. In the first place, the corners chip off and in the latter they rapidly wear, especially if drilling in abrasive rock. The heat treatment, in most mines today, depends on the eye of the blacksmith or helper. As it is impractical to draw temper on large drill steel, the heat treatment is generally conducted as follows: After sharpening, the steel is allowed to cool below the 'cherry red' temperature and then is given a 'short' heat. This means that only the extreme end of the drill, for a fraction of an inch, is heated to 'cherry red.' It is then 'quenched' thoroughly. The cutting edge is therefore of hard, untempered steel (fine grained, porcelanic texture), cushioned by a large mass of soft steel behind it. If the 'heat' at quenching is too short, the hardened portion will also be too short, and in drilling hard rock, will be driven back into the cushion, deforming the shape of the drill. If the heat is too 'long,' the cushioning effect is not sufficient and the corners chip off. Should the length of the heat be correct, the drill will stand up satisfactorily against the hardest rock, provided high-grade steel is used. As the color of the heated bit varies under different conditions of sunlight or artificial light, it is difficult to find a man who is able to heat and quench at the proper point.

If more attention were paid to the questions of sufficient steel at the working face and proper heat treatment of the steel, higher efficiency and lower costs would result. Several of the largest mines are going into the question of heat treatment, but the great majority of the mines are leaving this important factor to the blacksmith.

ABRASIVES FOR SANDBLASTING

BY H. D. GATES*

Tests of castings show shot and grit to have approximately 60 times the life of sand. In an instance of the use of grit with a hose machine, a steel foundry reports three tons loaded into the system and a loss of but 10 per cent. noted at the end of a month, while with sand the daily loss by disintegration was 25 per cent. This latter is undoubtedly excessive, and may have been due to a poor grade of sand. In this instance no advantage in rapidity of cleaning was apparent with the grit over the sand.

In another foundry the cleaning time of sand was reduced 20 per cent. by using shot. This seems logical, as the metal abrasives have two and a half times the specific gravity of sand. Records kept for six months showed, with same apparatus and conditions, that one pound of shot was equal to about 20 pounds of fine silica sand. Pieces cleaned were steel weighing approximately 200 pounds. The shot was of a size that an average of 33.7 per cent. was retained on number 20 mesh screen, and 66.3 per cent. on a number 40 screen. Experience in this plant was that shot made a great saving over sand, as it did better work, eliminated necessity of large storage bins, the cost of handling and driving sand, and by its lesser disintegration created less dust, making better conditions for the operator.

On the contrary in some experiments with metal abrasives on material to be electrogalvanized it was found that with equal power consumption perfect results were obtained with sand, while the metallic dust of the metal abrasive adhered to pieces, and imperfect galvanizing resulted.

On account of high cost of metal abrasives, their use with hose type machines must be confined to systems that have tight rooms and provide automatic handling. Thorough separation of dust and abrasive must be assured in the use of either for best efficiency, and the methods to obtain this adapted to the abrasive.

Use of a local sand is often possible, but aside from its abrasive value and hardness its size or grade will be of utmost importance, being governed entirely by size of nozzle.

While the larger the nozzle used, the greater the volume of work accomplished and the coarser the sand can be; air flow increases so with the larger nozzle that the available air supply for sandblast use must determine the nozzle opening, and it is obvious that the sand must be carefully screened to size in order to freely pass the nozzle.

*De La Vergue Machine Co.

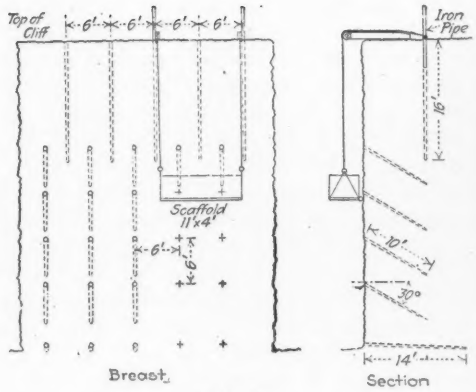


FIG. 1.

QUARRYING WITH AIR HAND DRILLS ON SCAFFOLDS, SLINGS AND LADDERS*

BY CHARLES C. PHELPS

Since the advent of the self-rotating hand hammer drill certain new methods of ledge and cliff excavation have been successfully developed which would have been impracticable with any previous type of drill. Formerly the familiar bench method was usual, the rock being removed in steps whose depth and width depended upon the size of mounted drills employed. Frequently deep holes were cut from the top of the cliff by churn drills and drill wagons.

In the new method, a support for the workmen is lowered over the edge of the cliff. There being no drill mounting to adjust, the time consumed in setting up and in changing steels is practically eliminated. This always consumes a large part of the time of operation with all types of mounted drills and explains the great economy of hand drilling. Yet the methods here described would have been impractical with earlier hand drills, due to the difficulty of rotating them by hand in inconvenient positions.

Fig. 1 and 2 show the scheme employed at the Campbell & Deane Co. quarry, Straw Plains, Tenn. The rocks is a hard blue limestone. Formerly, mounted piston drills (3½x 6-in. cylinders) were employed to remove the rock in benches. These were capable of drilling holes up to about 2¾ in. starting diameter, and a maximum depth of about 16 ft.

The present procedure is as follows: A row of vertical holes, 16 ft. deep and spaced 6 ft.

*Abstract from *Eng. News.*

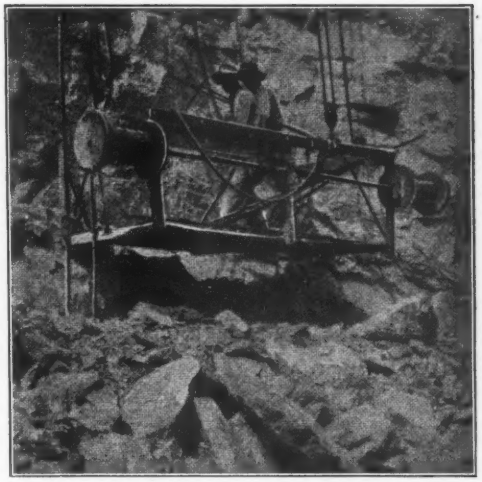


FIG. 2.

apart, is put in parallel with the face of the cliff by the tripod drills. Two lengths of gas pipe are inserted in the proper holes and ropes are fastened to them so that a scaffold can be lowered over the face of the cliff. The scaffold, shown in Fig. 2, is 11 ft. long and about 4 ft. wide. It is fitted with winding drums so that the drillers can raise or lower it after it has been slung over the cliff. The hand-drill holes are spaced 6 ft. apart, vertically and horizontally, and are 10 ft. deep. At this depth, the steels cut to about 1⅜-in. bottom diameter. The holes are inclined downward at an angle of about 30 degrees from the horizontal. Under present conditions, one man with a hand drill sinks about 80 to 100 ft. of hole per 10-hr. shift.

After the 10-ft. holes have been drilled from the top of the cliff to near the bottom, tripod drills are again put into use for drilling a line of horizontal holes on the very bottom of the cliff, these holes being 14 ft. in depth and looking down slightly from the horizontal. The holes in the side of the cliff are loaded each with 12 sticks of 60% dynamite and those at the bottom with 18 sticks. All of the holes are shot simultaneously (by battery). The cost of powder per cubic yard of broken stone is about 3½c. with this system whereas last year, when only tripod drills were used, the cost was 5½c.

Several big blasts have already been made. In the first shot that was set off an insufficient

quantity of powder was used, which resulted in large sizes of some of the stone. Later, 350 lb. was used (as noted above), and the cost quoted is based on this. It is believed that this amount can be reduced slightly and it is also contemplated using a slightly longer scaffold so that two or three drills can be used at once, which would result in a further lowering of operating cost. With the 350-lb. charge of powder, the rock is so well broken up that practically all of it can be handled by the steam shovel and crushers, requiring practically no block-holing.

The ease with which the automatically rotated hand hammer drill is handled in inaccessible quarters was further illustrated in work at the Bullwhacker Copper Company mines, at Butte, Mont. The difficult nature of the "glory hole" mining here may be realized when it is considered that it is 75 feet from the operator's position to the bottom of the cut, where the broken ore is mucked into cars and hoisted on an incline to the surface. The material is relatively low grade, averaging 4% copper, the vein running about 125 ft. wide at this point.

Frequently the operator works from a boatswain's chair slung over the side of the cliff. In a particularly difficult spot a suspended ladder had to be resorted to, the operator bracing himself against the ladder and having only sufficient room for one foot on the rock.

In spite of the exceptional difficulties at the Bullwhacker mine, the remarkable speed of 90 ft. of hole in two hours has been made, each hole bottoming at 6 ft. The rock, however, was not hard, it being an oxidized granite. Three-foot starting steels were used, followed by 6-ft. drills, the holes being for 1¼-in. powder sticks. In a single month, one drill broke enough ore to fill 64 cars of about 50,000 lb. each.

In the two instances cited, it twould be quite impossible to employ heavy piston drills. Ordinary plug drills would also be extremely difficult to operate because of the difficulty of rotating them by hand in such cramped quarters. With the self-rotating hand type, however, the operator has merely to apply the tool to the spot to be drilled and open the throttle. A simple steel holder attached to the front head of the hand drill has been found of material aid in withdrawing the steel from the hole. Moreover, it enables the drill runner to lower and raise the steel in the hole, churning up the cuttings and preventing sticking or binding. The latter troubles are still further provided against and the speed of cutting has been increased by a hole-cleaning device with which the operator can send at will a jet of air through the hollow steel to the bottom of the hole.

The writer desires to acknowledge the assistance of L. F. Thompson, of Knoxville, who furnished the data concerning the Campbell & Deane quarry, and of C. M. Hansen, of Butte, who supplied the information on the work at the Bullwhacker mine.

PNEUMATIC COAL TRANSPORTATION

In a paper read before the South Wales Institute of Engineers, Mr. Edward Koenings describes a pneumatic method of transporting small coal, such as peas, nuts, etc., which has met with some success. It is pointed out that the pneumatic principle has been applied in practice to the transport of seed, more especially corn, but only recently to coal. Small coal is not so uniform in size as a certain quality of grain, and it usually contains moisture which makes its suction into pipes difficult; a secondary trouble is the dust created. The difficulties have, however, been surmounted and the author proceeds to describe actual plants in use. One of these in Austria deals with 200 tons of coal in 24 hours, and consists of a double-cylinder air-pump by means of which a vacuum of about 10 inches is created in a cylindrical receiver, and two cylindrical dust catchers. To the lower part of the receiver three flexible suction pipes lead, each fitted with an isolating valve, so that either pipe may be used, two being for unloading wagons and one leading to a coal storage 200 yards away. Each suction pipe is fitted at the inlet with a special nozzle, and when in use the incoming current of air carries the coal and dust to the receiver, where the coal falls by its own weight into the lower conical part; it is ejected through an automatic air-tight discharge valve on to an automatic weigher, and subsequently passed to a receiving bunker. The dust in suspension in the receiver is drawn into the filters, collected and discharged in the same way as the coal, the remaining air passing through the pump for discharge to the atmosphere. The only attendants required by the plant are the engineer in charge of the pump and the workman looking

after the suction nozzle. The only important mechanism is the pump, and the operation is dustless so far as the workers are concerned. Another (German) plant is described for feeding 15 boilers. In this case the coal is taken from barges 160 yards away, lifted 110 feet and passed through the type of receiver mentioned, weighed and deposited in bunkers by means of a belt conveyor. In this instance no filter is used, as a dry lubricating air pump is installed, and dust collectors are fitted between the receiver and pump. The pump is rated at 2,400 cubic feet per minute; the capacity of the plant, 26 tons an hour from the barge, is increased to 45 tons if coal is taken from a bunker close to the receiver. The power required is 65 h.p., and the attendance from two to three men; it is estimated that the plant will pay for itself in two years. Another plant deals with eight tons an hour, over 100 yards and a height of 70 feet, and requires 18 h.p. The writer considers this form of transport most useful over a distance of 100 to 300 yards; the limiting size of coal he fixes at 2 inches, and of moisture at 6 per cent. He suggests that there may be scope for such apparatus for lifting small coal from the pit bottom to the surface.

SOME QUEER COMPRESSOR BUILDING EXPERIENCE

I think it will enliven my narrative to tell here the story of the Crown Point compressor. The Crown Point mine had long been under the control of the Bank of California crowd. It needed a new and large compressor, and I urged its management to order one of my new compound type, which they did.

We completed this compressor in four months and had it set up and tested in the shop, a fine foundation having been built for it at the Crown Point mine. Just about the time that we were ready to take it down for shipment the Bonanza crowd got control of the Crown Point mine. Mr. Taylor, president of the Risdon Iron Works, came to the office one morning in great trouble and called me into a private room to inform me that the enemy were in control at Crown Point and it was all up about the compressor.

"Now," said he, "you seem to be on better terms with Mr. Fair than any of us, and I want you to go up to his office and see what you can do about it." So to Mr. Fair's office I went with great trepidation, for he might be in a bad humor, in which case I had little chance of accomplishing anything. I found him in his office evidently elated over the Crown Point business. When I entered he said heartily, "Be seated, Mr. Dickie; now what can I do for you, my son?"

"Mr. Fair," I said, "I have come up to see you about the new compressor for Crown Point. It is all ready and has been tested in the shop, and I thought you might like to come down and see it run before we ship it."

"But," he replied, "I do not want that compressor."

That remark made me feel rather downhearted, so I ventured cautiously to extol the virtues of my compressor, and said, "Mr. Fair, why don't you want that compressor; it will be more economical than any compressor now on the Comstock by at least 30 per cent."

Then he let me in on some of the economics of mine control by replying, "Now, my son, you've got it. We have got control of that mine, so that if we can't get metal out of her we can put wood into her; we are selling Crown Point 80 cords of wood per day and an economical compressor will cut down our sales."

"Mr. Fair," I said, "the foundations are all complete and the holding-down bolts in place, ready to receive the compressor, and you cannot afford to leave it incomplete, so you had better let me ship it, especially as a great many mining men are anxious to see how it will turn out."

"Now, my son," he said, "you had better not say anything more about it; we are not going to take that Compressor." "Then," said I, "what are you going to do about our contract?" "Oh, you have a contract have you? Robert, where is that contract with the Risdon for a compressor? Ah, my son, here it is, $46,000. It seems to be all right. Robert, make out a check to the Risdon Iron Works for $46,000 on Crown Point account."

BURYING A NEW IDEA

"That's all right,"I said, "but what are we to do with your compressor?" "How big is this thing, my son?" I told him about 20 ft. long, 17 ft. high and 8 ft. wide. "Well, my son, it's pretty big—too big to bury it standing up, as you get into water pretty quick

down at your place, but dig a nice hole and lay it on its flat. You can go down 9 ft., and cover it up carefully; no headstone, I want your compressor to have a nameless grave and we'll say no more about it."

So ended the chance for a real two-stage compressor, and it was 15 years before anyone else built a compound compressor. Passing some time ago the site of the old Risdon Iron Works, I came across one or two parts of the old Crown Point compressor; probably no one but myself could identify them. In those days we had some rather strange experiences in our endeavors to advance science and engineering.—*Geo. W. Dickie in American Machinist.*

SOMETHING FOR NOTHING IN COMPRESSED AIR

The following comes to us from the *Kansas City Post.* The device spoken of will evidently be a wonder when the "few alterations" are completed.

An engine that runs itself on its own power, developing energy to operate machinery, has been invented in this city. The inventor has been working for five years on his self-operating engine, and now has it near perfection. A few alterations are to be made. These will increase its efficiency. The engine is run by compressed air, making its own pressure as it runs. The exhaust from the cylinders returns through a series of eight-port automatic valves, to a large steel pressure tank. This tank is a double affair, there being a smaller tank within the larger one. An air space of 6-in. intervenes between the two tanks. Into the air space the exhaust from the cylinders is forced, the action being such that the nitrogen gases are separated from the oxygen and, forming a lighter gas, rises to the top of the tank, at the same time creating a pressure which forces the fresh air down through the inner tank and back into the engine, which is operated by this pressure.

OXYGEN SUPPLY WITHOUT PRESSURE

Instead of using strong mechanical containers for oxygen as a compressed gas chemical constraint can be substituted. Thus oxone is a substance in which oxygen is held in chemical bonds, but is releasable by the application of water. Just as water reacts with calcium carbide and forms acetylene gas and lime, so water reacts with oxoe and forms oxygen and sodium hydrate. A pound of this reagent holds 2.2 cub. ft. of gas or 60 litres of oxygen at normal pressure and temperature. Thus a pound of oxone should furnish a man enough oxygen for 30 minutes of use. The oxygen evolved is said to be 99 to 100 per cent. pure, the only impurity consisting of a slight vapour caused by the energy of reaction. This is readily absorbed by passing the gas through water. The gas is then of 100 per cent. purity. Oxone is a commercial preparation of fused sodium peroxide of specific gravity 2.43. It is hard, but not brittle, and is capable of being cast into any convenient shape, and it is said it can be stored without danger and even without deterioration if protected from moisture.

A PLANT THAT COUGHS

All have read of carnivorous plants, of laughing plants and of plants that weep, but who has heard of a plant that coughs? There is a plant in various tropical regions which actually possesses the power to cough in the most approved manner. It appears that the coughing plant is something of a crank, that it easily works itself into a rage, and that it has a curious horror of all dust. As soon as a few grains of dust are deposited on its leaves the air chambers that cover their faces and are the respiratory organs of the plant become filled with gas, swell, and end by driving out the gas with a slight explosion and a sound that resembles so much the cough of a child suffering from a cold as to carry a most uncanny sensation.

A STONE QUARANTINE

Probably for the first time in the history of the world a quarantine has been declared against stone, and it is now being enforced against the quarry products of certain parts of New England. Owing to the fact that egg clusters of gypsy moth were being distributed on quarry blocks from the infected districts to other sections of the United States, the Secretary of Agriculture placed such products under regulation as to interstate movement by a quarantine effective October 23, 1914. In accordance with this action the railroad companies have notified shippers that before any car, box or other container can be moved from the infected districts, it must be plainly marked and bear a certificate of inspection.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

W. L. SAUNDERS, - - - - - Editor
FRANK RICHARDS, - - Managing Editor
CHAS. A. HIRSCHBERG, - Business Manager
W. C. LAROS, - - - Circulation Manager

PUBLISHED MONTHLY BY THE

Compressed Air Magazine Company

Easton, Pa.

New York Office—11 Broadway.
London Office—165 Queen Victoria Street.

Subscription, including postage, United States and Mexico, $1.00 a year. Canada and abroad, $1.50 a year. Single copies, 10 cents.
Those who fail to receive papers promptly will please notify us at once.
Advertising rates furnished on application.

We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

Entered as second-class matter at the Easton, Pa., Post Office.

Vol. XX. JANUARY, 1915. No. 1

CONTENTS

Special Compressor in Edison Fire..... 7459
Electric-Air Coal Mine..... 7460
Handling Concrete with Compressed Air 7465
Newest Rock Drilling Practice..... 7460
Electric-Air Drills on Mesabi Range.... 7470
Calibrating Venturi Meters..... 7471
Behavior of Explosive Mixtures..... 7472
Brushing vs. Blowing..... 7473
Gas Engine Horsepower at Altitudes.... 7474
Care of Drill Steels and Efficiency..... 7474
Abrasives for Sandblasting..... 7476
Quarrying with Air Hand Drills..... 7477
Pneumatic Coal Transportation..... 7478
Queer Compressor Building Experience.. 7479
Something for Nothing in Compressed Air 7480
Oxygen Supply Without Pressure..... 7480
Plant that Coughs..... 7480
Stone Quarantine 7480
Our Great Disappointment..... 7481
Rock Drills at North Star Mines..... 7482
Small Portable Compressor..... 7483
Tests of Largest Turbo Compressor.... 7484
Notes 7486
Patents 7487

THE GREAT DISAPPOINTMENT

With our present issue another volume of COMPRESSED AIR MAGAZINE begins, and it would be quite natural for us to be thinking and speaking of its outlook for the future. With world affairs in normal condition it should be expected that we would be considering the special topics to which our publication is ostensibly devoted; but it is impossible to forget or ignore the conditions under which we are at present existing. All the world is upset, and wiseacre historians hundreds of years hence will be showing that the upsetting was the operation precedent to a firmer settling of the foundations of life and conditions on the globe, and that the cost of the repairs was commensurate with the value of the work accomplished.

Nevertheless, the universal tragedy of the present, in view of what we were confidently expecting of permanent peace and continued average prosperity and progress, must, for the time at least, stand for one of the world's great disappointments. It came upon us with startling suddenness, and to the masses of mankind as a complete surprise, and if it could have been predicted in advance it would have been almost universally declared impossible. Under existing conditions perhaps the most futile of undertakings is to attempt to place the blame for it all, except in so far as that may lead to the means of restoration and readjustment. All that we can do is to take things as they come and to hope and resolve that so far as may be possible we shall keep out of more immediate contact with the great trouble.

When we come to look into the actualities of the great war we find that pneumatics in one way or another is involved in all the great operations. This war has developed departures from the traditional ways of fighting, and has sprung surprises in the development of efficiencies along unusual lines that are the wonder alike of the expert and of the uninformed. Sky craft and the submarines were never employed until the present war; now they are the most terrible and, directly or indirectly, the most effective and terrible of all the agencies employed, and air is as essential in the operation of the one as of the other.

Compressed air has been working quite innocently but quite constantly toward the development of the most effective of the phys-

ical agencies of the destruction now so active. The rock drill in quarry and in mine, in driving tunnels and in all rock excavation, has continually stimulated the development of the high explosives, and now we reap the benefit in the harvest of death.

TESTS OF ROCK DRILLS AT NORTH STAR MINES, CALIFORNIA

BY W. L. SAUNDERS

[The following is a discussion of a paper with the above title by Robert H. Bedford and William Hague, presented at the Salt Lake meeting, August, 1914, of the American Institute of Mining Engineers and printed in the Bulletin of the Institute No. 92].

Messrs. Bedford and Hague have given us a very interesting and practical paper. No better excuse for such a paper could be desired than the statement made that the expense of drilling in this mine is one-third of the cost of delivering the ore at the mill. This statement should be written in red letters, because it applies to a great many mines besides the one referred to and because it is generally true that in a mining plant, as also in papers read before the Institute, more attention by far is given to the metallurgical side of mining than to the excavation of the ore, and no study of the excavation work is properly made that does not involve a careful inquiry into the merits of the rock drill used.

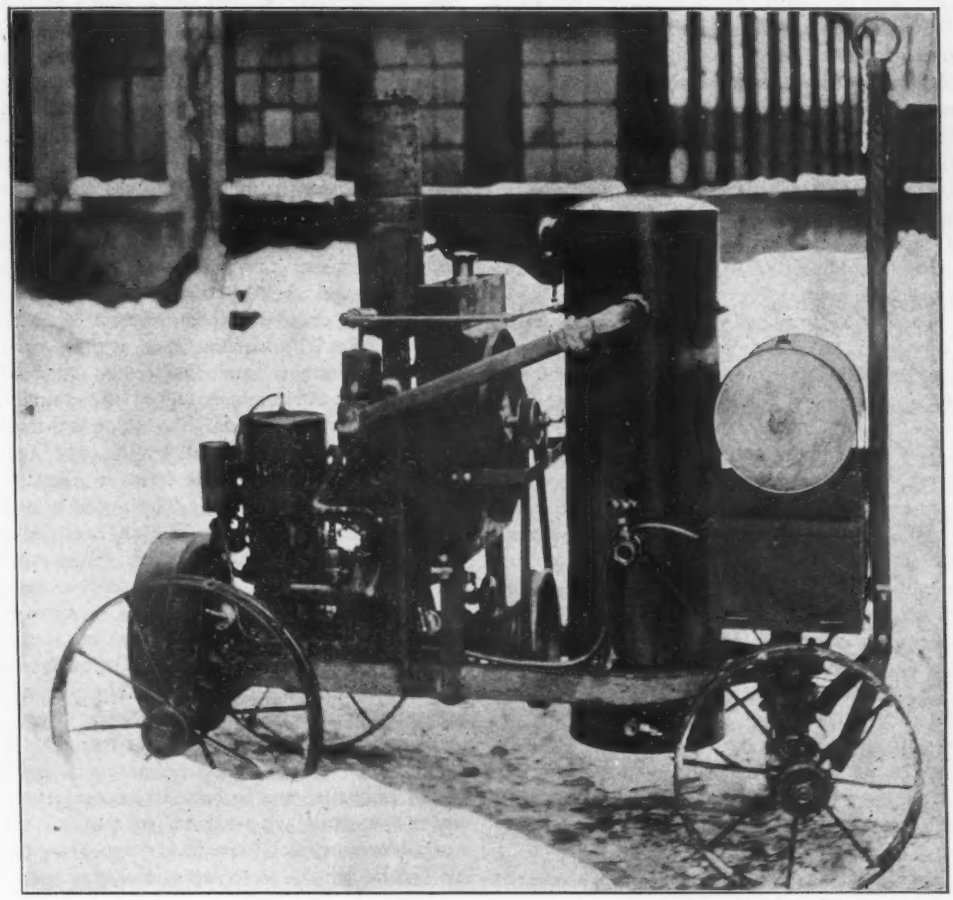
Next in importance to the selection of a good rock drill, in a case where the actual drilling cost is one-third the cost of delivering the ore, is that the drill should be maintained in order and kept up to its highest efficiency. The best rock drill may run down in efficiency through accidents, wear, or other conditions which are sometimes beyond supervision or control. The machine is usually in the hands of men who know how to get work out of it, not men who know how it works. The best drill runners are not machinists, but miners. They could not tell you how the valve operates or the principle of the rotation, but they know how to get the work done. A testing machine, particularly the type described in this paper, may be of the greatest value in maintaining a uniform state of efficiency.

It must not be supposed, however, that this testing machine in itself will distinguish the value of one type of drill from another. This has been referred to in the paper, where it is shown from the record that drills developing the greatest horse power of energy were not the most efficient in drilling capacity. This is referred to on p. 1814 and it is corroborated by the tables on p. 1813, where the foot-pound blow of approximately 40 to 45 lb. is shown to be the most efficient for this particular class of work.

At the works of the Ingersoll-Rand Co. testing machines of practically the same principle as that described have been in use for several years. Drills are tested on these machines and afterward operated in an experimental underground mine, where it has been shown that the maximum foot-pound energy does not always mean maximum drilling capacity. The efficiency of any type of rock drill depends mainly upon the proper adjustment of the air pressure to the nature of the rock. In certain rocks a slow-moving, heavy foot-pound blow will show the best results in drilling, while in other rocks the fastest drilling is done through a rapid blow of light foot-pound energy.

The testing machine, however, is a guide in showing comparative results under similar conditions and it is a valuable means by which from time to time a drill may be tested to determine whether or not it has deteriorated. A rock drill that is not up to its maximum efficiency should be examined and the cause discovered and remedied.

It is to be regretted that Messrs. Bedford and Hague did not give us a little more information concerning the tests given in the tables. These tables at a glance indicate that a comparsion has been made between the cost of operating a water Leyner No. 8 drill and a Waugh 12-A. I feel quite sure, however, that there is no comparative test intended, because, in the first place, one machine is a rock drill of the mounted type while the other is an unmounted stoper. In these tests the Leyner drill was used for heading work, which means that a larger proportion of the holes are flat and down-holes. Such work, as every one knows, is more difficult and is harder on the steel than work, commonly known as stoping, with air drills, which is usually up-hole work, the drills clearing themselves of cuttings during operation. This point has a bearing upon the statement showing the amount of steel consumed and the cost per shift for sharpen-



PORTABLE GASOLINE ENGINE COMPRESSOR.

ing the steel. There can be no comparative value placed upon tests of steel cost except when used in the same class of work. Furthermore, the Leyner drill was used with round steel while the stoper used the cruciform pattern. The statement is also made that 2-in. bits were used with the stopers and 2¼-in. with the Leyners.

Another point worth mentioning is that the Leyner drill (No. 8) referred to in this paper is no longer made, it being an obsolete pattern, the present type being No. 18.

The point brought out in this paper that the force of the air feed on a stoper has a very material effect upon its drilling capacity is one not generally considered, but it is of the utmost importance in stoper service.

A SMALL PORTABLE AIR COMPRESSOR

The small gasoline-engine-driven portable air compressor illustrated above has been developed by the Ingersoll-Rand Company, particularly to meet the needs of the contractor doing work of a temporary character requiring compressed air in small quantities, such as the laying of gas and water mains, where air tools of various types are used, for cutting asphalt, tearing up roadways, rock cutting, calking lead joints, drilling and riveting on steel pipes, tamping earth, etc. Compressed air tools have demonstrated their merit on this class of work and in every case have proved a considerable saving, both in time and labor, over hand methods.

This compressor being portable and self

contained is admirably adapted to this work. It is operated by a simple single cylinder gasoline engine which is coupled directly to the compressor, both pistons working from alternate cranks on the same shaft. The engine is of the single acting, two cycle type, closely following the well known marine designs. The air compressor, which is one of the Companies standard types, known as "Imperial XII," has a capacity of 45 cu. ft. per minute at a pressure of 90 lb.; it is fitted with an air unloader and the engine with a centrifugal governor.

Cooling is provided for by a gear driven pump and an automobile type radiator with large tank capacity, serving both the compressor and engine. The radiator is assisted by a large fan.

The frame, axles and wheels are of steel, the front axle is arranged with a swivel connection to the frame, permitting horizontal rotation for turning corners and sufficient vertical movement to accommodate the wheels to inequalities of the road without strain on the frame.

An air receiver, tested to 300 lb. water pressure and fitted with safety valve, pressure gage, necessary piping, outlets, etc., is hung at one end of the frame, and a gasoline tank of 15 gallons capacity is supported on a large tool box as shown in the illustration.

The outfit complete weighs 1600 lb.; it is designed for hand transporation but can be fitted for horse traction if desired.

This outfit is rated in terms of pneumatic tools of its make as follows:

Three medium size "Little David" chippers.
Two "Crown" pneumatic picks.
Two "Little David" riveting hammers.
One "Little David" wood boring drill or one metal drill.
Two "Crown" sand rammers.
Two small plug drills or one Jackhamer.
One medium size "Imperial" hoist.
Ten small stone tools or six of the large size.

TEST OF THE LARGEST AIR COMPRESSOR

BY G. M. CLARK.*

The official test of the largest turbo-compressor hitherto constructed marks an epoch in the history of the design of such machines, and is therefore worthy of a fuller description than would generally be accorded to a taking-over test between a contractor and a purchaser. The machine is used for delivering compressed air to the mines belonging to the Rand Mines, Limited. Air is delivered through a network of pipes 30 miles in length and varying in diameter from 27½ inches downwards to 20 points of supply at a pressure of 100 to 110 pounds per square inch gauge pressure. The total capacity of these pipes is nearly 90 tons (of 2,000 pounds) of air, and the power installed to drive the compressors is nearly 60,000 K.W. The machine runs at 3,000 revolutions per minute, and is rated at 7,000 K. W. on the turbine, and is one of three similar machines installed under the same contract. The machine has an overall length of 56 feet. The low-pressure stage is next to the turbine, and is double ended. The air at atmospheric pressure is taken in at each end, and is discharged by a duct at the centre. This automatically balances the end thrust on this stage. From the first stage the air passes through the first intercooler, then through the second or intermediate stage, and then through the second intercooler, and, finally, through the high-pressure stage. All stages are water-jacketed, and water also circulates through the diaphragms. Compressed air contains no more energy than the same volume of uncompressed air at the same temperature, so that all the work done in compression has to appear in the cooling water. The compression that takes place in the first stage is from atmospheric pressure to about 0.8 atmospheres above, whilst the second stage raises the pressure to nearly 3.0 atmospheres, and the final stage to 9 atmospheres gauge pressure. The temperature of the air entering the compressor is nearly 20°C., with a rise to 80°C. at the end of the first stage. It is again cooled to 30°C. in the intercooler with circulating water at 20°C., and leaves this stage at about 100°C., after which it is again cooled to 35°C. in the second intercooler, and finally rises to 90°C. in the high-pressure stage. The isothermal compression is completed by the final cooling in the pipe line distribution system to the original atmospheric temperature of 20°C. These temperatures and pressures vary with the load on the machine, but the above statement is nearly accurate for the full load of the machine.

The tests, which were carried out in Au-

*South African Institute of Engineers.

gust, 1914, were officially for the purpose of deciding whether the guarantees were fulfilled, and subordinately for the purpose of giving information to the operating staff as to the behaviour of the machine. The Power Company does not sell air in terms of air-kilowatt hours as defined above, but in terms of air units, which are defined as 64.1 per cent. of an air kilowatt hour. This fraction was introduced so that the selling price of an air unit and of an electric unit might be the same. It would have been as simple to have sold air by the air-kilowatt hour and made the price of each 100/64.1 of the price of an electric unit. This air unit is introduced into a part of the subsequent calculations and represents approximately what the machine would have done had an electric generator been attached to the turbine instead of a compressor. The figures derived from air units will thus be more familiar to electrical engineers than those derived from the air kilowatt. Though the method of testing and calculation had already been agreed and accepted, these tests are of such interest, and the results are of so great importance, that other methods of calculation have been used, and it is gratifying to know that the guarantees are fulfilled independently of the method of calculation.

The conclusions to be derived from this report on the tests is that, whilst a very great advance has been made in the size of turbo-compressors, this advance has been accompanied by another great advance in the science of design, so that the efficiency is now at least 10 per cent. above that of machines previously constructed by the same designers. From the figures given it is probable that three-quarters of the energy of the steam is convertible into mechanical work on the shaft of the turbine, and of the work on the shaft two-thirds can be utilized in the isothermal compression of air with compression ratio of nearly 12. Thus on the whole there has been an increase from a conversion of little more than 40 per cent. of the steam energy to practically 50 per cent. The report incidentally shows that the orifice method of measuring air and water is capable of being used with an accuracy equivalent to the commercial accuracy of electrical measurements. There is no doubt that measurements taken in this way are so accurate that to allow a tolerance of 2½ per cent. for accuracy of measurements is altogether too great. The report shows the facility with which steam measurements may be handled when the notion of the steam kilowatt is introduced, and the use of the Mollier diagram when converted to read steam energy directly in kilowatt hours per pound of steam gives immensely increased power of thought in all questions of turbine economy as compared with the use of ordinary steam tables.

A SAFETY FIRST TUNNEL

Out in the Cascades the Chicago, Milwaukee and St. Paul Railroad has just completed, after two years' work, a 12,000-foot bore through the granite and slate of the mountains without the loss of a single life. The St. Gothard tunnel in Switzerland, which is similar to the St. Paul's, took eight years to build and cost 800 lives. The St. Paul people have called their new tunnel the "lucky tunnel." During its construction, which took three years less time than had been at first calculated, giant air compressors kept the bore supplied with fresh air, while pulmotors, oxygen helmets, and every other safety device obtainable were employed to protect the men. The tunnel has been misnamed. It was not luck that made possible the completion of such a work without the sacrifice of a human life. It was a strict adherence to the principles of "safety first," and the result excellently serves to illustrate what can be accomplished when a real serious effort is made to throw every safeguard possible around men engaged in hazardous undertakings. So rather let the St. Paul name the bore through the Cascades the "safety first tunnel."—*Exchange, Unidentified.*

TWO KINDS OF CUT SUGAR

In the modern manufacture of "cut loaf" sugar, the "loaf" being a reminiscence of the older days when sugars were first made in loaves and then broken into pieces, the sugar is made in the ordinary way by the vacuum pan process, with large crystals and this large crystalled sugar is then moistened with a liquor or syrup made of pure white sugar and this is sprinkled in among the crystals to secure a certain degree of stickiness, or of adhesion of the crystals to each other, and the mass of sugar is then made into thin plates of about three-quarters of an inch thickness and then dried by artificial heat. In this way the

brilliancy of the crystals is maintained and the sugar then is cut up into the little blocks with which we are familiar, certain indentations in the moulds directing the lines of cleavage, and we have the first-class cut loaf sugar.

In order to turn out a cheaper production there was invented a machine for making compressed cubes out of sugars from the centrifugals, generally of rather a small grain, and retaining some of the moisture which, with the compression in the cube sugar-making machines, made it possible to turn out the little compressed cubes with a smooth surface with which we are all familiar.

NOTES

The New York Public Library has recently published a 34 page pamphlet containing a list of works relating to oxy-acetylene welding which may be found in the library. The arrangement is chronological by date of publication from 1893 to October, 1914, and specifies 487 books, pamphlets, magazine articles, etc., indexed both by subjects and authors.

Over one-fourth of a factory's yearly coal bill is directly controlled by the firemen. In New England a single fireman will burn $40 to $50 worth of coal a day in a 500 horse-power plant. That is $12,000 to $15,000 worth of coal a year. This man receives from $1.75 to $2.50 per day for his work. Depending upon the skill with which he handles his shovel, he will waste or save $3,000 to $4,000 a year of his firm's good money.

The new third lock of the St. Mary's Falls canal system, said to be the longest lock in the world, was formally opened to navigation, Oct. 21. The lock is 1,250 ft. long, 80 ft. wide and 23 ft. deep. Its construction was begun in 1908, and the cost is given as $6,250,000.

A well-deserved and too seldom accorded honor is to be given to engineers by the Baltimore and Ohio Railroad. The four tunnels on the Magnolia Cut-off between Orleans and Little Cacaton, West Virginia, are to be named after four of the road's chief engineers: James L. Randolph, J. M. Graham, D. D. Carothers and Francis Lee Stewart.

The following is the record of heading progress on the Rogers Pass Tunnel of the Canadian Pacific Ry. for November:

East end, center heading, 588 ft. Schist with some quartzite.

East end, pioneer heading, 529 ft. Quartzite with some schist.

West end, pioneer heading, 817 ft. Slate with small quartzite bands.

West end, center heading, 654 ft. Slate with small quartzite bands.

The west end pioneer heading footage is believed to be the American record of rock-tunnel progress. This heading was driven down grade through rock that could not be broken over 6 ft. per round. The best day's progress was 37 ft. Joseph Murphy is Assistant Superintendent at the east end, and Joesph Fowler is Assistant Superintendent at the west end; A. C. Dennis, Superintendent; Foley Bros., Welch & Stewart, contractors.—*Eng. News.*

Ebensburg No. 1 mine of the Ebensburg Coal Co., at Colver, Penn., for the month of October, produced 102,700 net tons. This is remarkable, when it is considered that this is from a single opening, and the seam of coal only 3½ ft. high.

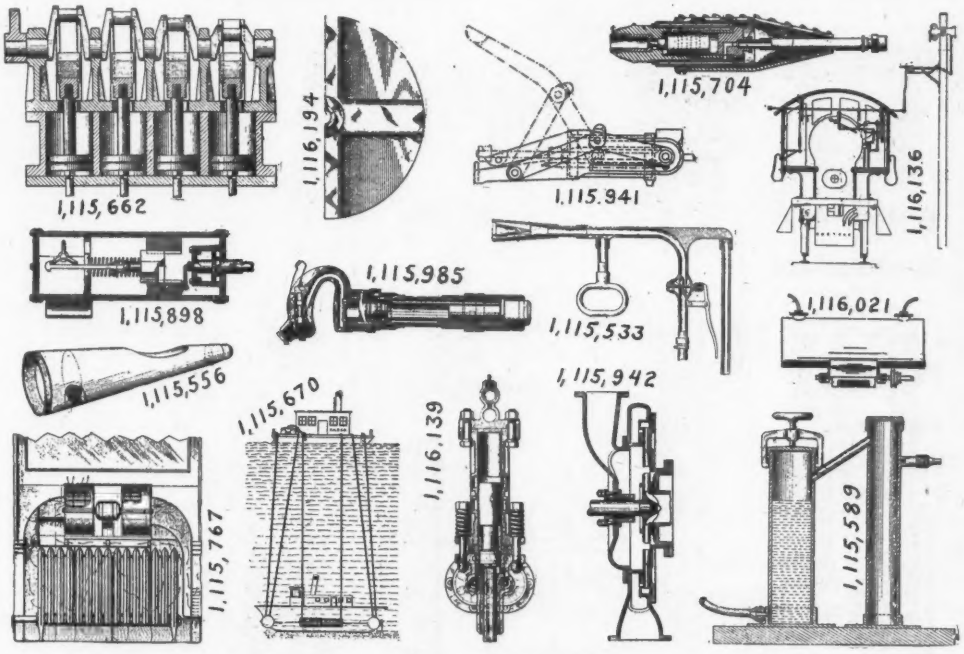
What is said to be the largest stack in the construction of any office building is that of the Equitable, New York City. It is 11 ft. in diameter and 596 ft. high. The two stacks of both the Campania and the Lucania, of the Cunard Line, were each 21 ft. in diameter.

Cost of working a 900-hp. Diesel engine at the Anheuser-Busch brewery, St. Louis, totals 0.6506c. per kilowatt-hour as follows: fuel oil, 0.2850c.; lubricating oil, 0.0263c.; water, 0.0388c.; supplies, 0.0043c.; labor, 0.2750c.; and maintenance and repairs, 0.0212 cents.

Commercial rubber which is kept in perfectly dry air is not capable of furnishing nutriment to any form of microbe, but in the presence of sufficient moisture it may be attacked by certain bacteria or molds which feed on albuminoids, resins, and sugars. Some microbes form red, yellow, brown, or black spots on rubber without sensibly altering its properties. But there are two species of Actinomyces which are able to assimilate the

hydrocarbon of rubber, and which may therefore so modify its properties as to destroy its value.—*Scientific American.*

The value of carbonic acid gas as a plant nutrient has been the subject of considerable recent literature, including an interesting paper by H. Fischer, describing experiments in Germany. The author found that the development of both foliage and flowers was stimulated by an excess of carbonic acid in the air, while the yield of tomatoes was doubled and that of cucumbers increased 12.5 per cent by carbonic acid treatment. It has generally been held that 0.03 per cent. of carbon dioxide in the air is sufficient for plant growth, but Mr. Fischer thinks that more than this can be utilized, provided there is ample light, and that experiments in this direction might give valuable results.



PNEUMATIC PATENTS NOVEMBER 3

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

NOVEMBER 3.

1,115,533. BOILER-TUBE BLOWER. ROY HARTWELL, Marion, Ill.

1,115,556. SOAP-BUBBLE-BLOWING DEVICE. GEORGE M. LITTLE, Pittsburgh, Pa.

1,115,589. APPARATUS FOR INJECTING LIQUIDS INTO PNEUMATIC TIRES. JACOB J. SEAMAN, Winfield, Kans.

1,115,644-5. AIR-BRAKE MECHANISM. JOHN B. WRIGHT and FRANS O. LAWSON, Greensboro, N. C.

1,115,662. FLUID-PRESSURE CONTROL DEVICE. LELAND F. GOODSPEED, Milwaukee, Wis.

1,115,670. DEVICE FOR RAISING SUNKEN VESSELS. FLORE HENGYE, Joliet, Ill.

1,115,704. PNEUMATIC - HAMMER MUFFLER. EDWARD MANES, Golden, Ill.

1,115,767. AIR-CONDITIONING APPARATUS. FOREE BAIN, La Grange, Ill.

1,115,770. PNEUMATIC - DESPATCH - TUBE APPARATUS. BIRNEY C. BATCHELLER, Philadelphia, Pa.

1,115,898. HAMMER-DRILL. ANDREW J. CARTER, Victor, Colo.

1,115,941. MANUAL OR FOOT-OPERATED AIR-PUMP. HENRY THOMAS HUTTON, Donaghadee, Ireland.

1,115,942. CENTRIFUGAL PUMP AND AIR COMPRESSOR. WALTER KIESER, Charlottenburg, Germany.

1,115,985. PNEUMATIC HAMMER. LEWIS E. SUMMERS, Detroit, Mich.

1,115,511. SAFETY DEVICE FOR PUMP-GOVERNORS. PHILIP L. CRITTENDEN, Edgewood, Pa.

1,116,021. MILK-RELEASING MEANS IN VACUUM - OPERATED MILKING - MACHINES. JOSEPH HARVEY CORNISH, Barham, New South Wales, Australia.

1,116,136. AUTOMATIC AIR-BRAKE-OPERATING MECHANISM FOR RAILWAY-TRAINS. WALTER R. SHAW, Bradford, Pa.

1,116,139. DRILLING-MACHINE. MATHER W. SHERWOOD, Franklin, Pa.

1,116,194. VACUUM - PRODUCER. JOHN WYNN, JR., Canton, Ohio.

1,116,346. FLUID-PRESSURE ENGINE. WALTER W. MACFARREN, Pittsburgh, Pa.

1. A fluid pressure engine comprising in combination, means for regulating the pressure of the entering fluid, and means operated by pressure derived from fluid which has passed the first named means and arranged to vary the point of cut-off in such relation to the stroke as to permit expansion to be carried substantially to a uniform point before exhausting.

NOVEMBER 10.

1,116,368. VACUUM UNIT-VALVE. MILES E. BELL, Minneapolis, Minn.

1,116,374. VACUUM PISTON MECHANISM FOR LOCOMOTIVE DRIFTING-VALVES. JOSEPH BILLINGHAM and CHARLES F. KAHLER, Schenectady, N. Y.

1,116,708. MILKING-MACHINE OPERATED BY COMPRESSED AIR OR THE LIKE. FRANS J. JOHANSSON, Stockholm, and EMIL A. O. GOTHE, Nynashamn, Sweden.

1,116,720. METAL - CASTING MACHINE. JAMES J. MCGUIRE, Newark, N. J.

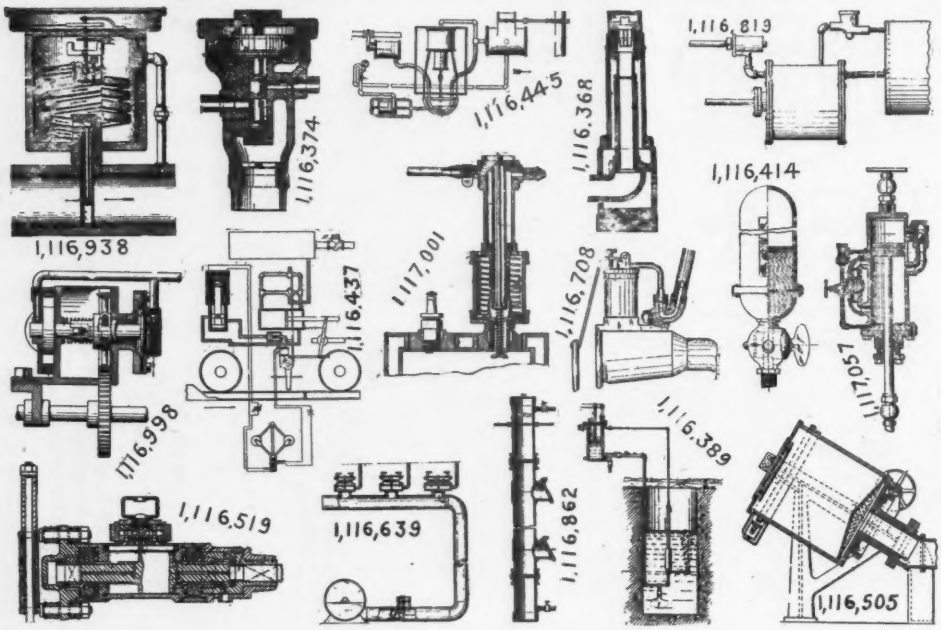
1,116,777. REDUCING SYSTEM. MILTON F. WILLIAMS, St. Louis, Mo.

1,116,819. FLUID - OPERATED BRAKE. GEORGE E. HOTTENSTEIN and ROBERT Z. FARMER, Bisbee, Ariz.

1,116,850. SUCTION CLEANING DEVICE. GEORGE C. SCHMITZ, Racine, Wis.

1,116,862. PNEUMATIC CONVEYING DEVICE. WILLIAM WALLACE WOTHERSPOON, New York, N. Y.

1,116,938. FLUID-FLOW METER. LUCIAN A. SHELDON, Schenectady, N. Y.



PNEUMATIC PATENTS NOVEMBER 10.

1,116,389. PUMPING MECHANISM. CHARLES W. COLLINS, Tiffin, Ohio.

1,116,414. DEVICE FOR PREVENTING WATER-HAMMER. ROBERT D. GOULD, Superior, Wis.

1,116,437. AUTOMATIC TRAIN-STOP. ELMER M. JONES, Atlanta, Ga.

1,116,445. AUTOMATIC SAFETY DEVICE. EDMUND JOHN LACLAIR, Providence, R. I.

1,116,505. SAND-BLAST APPARATUS. WILLIAM W. SLY, deceased, Cleveland, Ohio, by Wilfred C. Sly, administrator, Cleveland, Ohio.

1,116,519. PERCUSSIVE HAMMER, DRILL, AND THE LIKE. WILLIAM HENRY WAKFER, South Norwood, England.

1,116,530. PNEUMATIC MUSICAL INSTRUMENT. HARRY J. ANDERSON, Chicago, Ill.

1,116,564. AIR-BRAKE SYSTEM AND APPARATUS. NIELS A. CHRISTENSEN, Milwaukee, Wis.

1,116,639. VALVE FOR ORGAN-BLOWERS. IRA H. SPENCER, West Hartford, Conn.

1,116,647. AIR-WASHER. GUY P. THURBER, Pittsburgh, Pa.

1,116,675. AIR-GUN. EDGAR P. COOK, Granville, Ohio.

1,116,998. PUMP CONTROL. MELVIN D. COMPTON, New York, N. Y.

1. A pneumatic device comprising the combination of an air compressor and an air line, a driving clutch for the compressor, a diaphragm for throwing the clutch, reversely acting check and relief valves and their ports for admitting and exhausting air to and from the diaphragm, and means for constantly exposing said valves to the air pressure in the line, whereby the compressor is automatically run when the air pressure is below a certain limit and is automatically stopped when the air pressure is above a certain limit.

1,117,001. AIR-PUMP. JAMES K. DALTON, Waverly, Ohio.

1,117,057. AIR - SPRING AND SHOCK - ABSORBER. JOHN KOHNER, Lewiston, Minn.

1,117,119. SAND-TRAP. WILLIAM H. WHITE, Roanoke, Va.

NOVEMBER 17.

1,117,254. FLUID-PRESSURE BRAKE SYSTEM. WILLIAM H. SAUVAGE, New York, N. Y.

1,117,267. VACUUM REGULATION. HOMER CLYDE SNOOK, Philadelphia, Pa.

1,117,289. TRIPLE VALVE. WILLIS C. WEBSTER, Dubois, Pa.

1,117,307. FLUID-OPERATED TOOL. LEWIS C. BAYLES, Easton, Pa.

1,117,329. TIRE - PRESSURE INDICATOR AND ELECTRIC SIGNAL. CHARLES C. CLEVELAND, Boulder, Colo.

1,117,394. AIR COMPRESSING AND STORING SYSTEM. NELS JOLEEN, Chicago, Ill.

1,117,461. ROTARY COMPRESSOR. FRANK S. STRITE, Seattle, Wash.

1,117,548. SUCTION SUPPORTING DEVICE. AUGUST BOUCHERY, New York, N. Y.

1,117,554. DRILL-PULLER. HOWISON CROUCH, Grass Valley, Cal.

An attachment for a hammer rock drill comprising a flexible member provided at one end with means for gripping the shank of a drill steel and at the other end with a bracket arm, the end of which is bent at an angle and adapted to be inserted into the drill socket of the rock drill so that upon supporting the rock drill in reversed position and reciprocating the hammer thereof, the impact of the latter will exert a pulling force upon the drill steel.

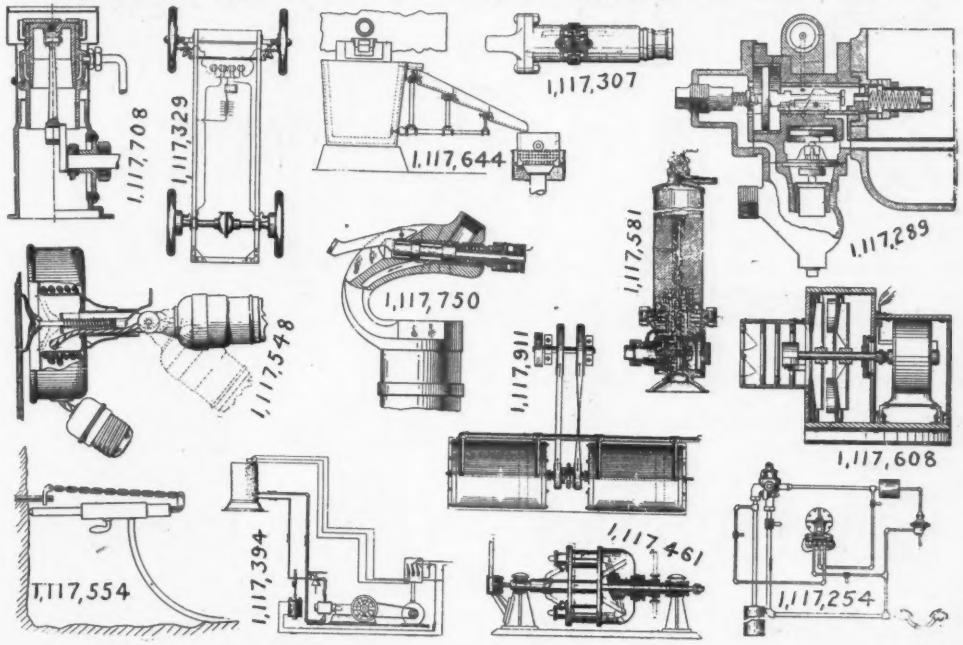
1,117,750. SAFETY LOCKING DEVICE. CHARLES F. ALBRECHT, Cleveland, Ohio.

1. A fluid pressure operated tool comprising, in combination, a barrel or cylinder, a handle for said barrel or cylinder provided with a passageway for pressure fluid, a valve in said handle adapted to control the flow of fluid through such passageway, a trigger carried by the handle for operating the valve, a device adapted to engage the valve and block it against movement by the trigger, means for retaining said device in blocking position, and a spring arranged to move said device out of valve-blocking position when the said device is released.

1,117,784-5. MEANS FOR HUMIDIFYING ARTIFICIALLY-HEATED AIR. ADDISON A. CARDWELL, Rye, N. Y.

1,117,786. REFRIGERATING APPARATUS. CARL A. V. CARLSSON, Washington, D. C.

1. The combination with an air circulating refrigerating system, employing high and low air pressures, and a source of supply therefor, of means automatically operated by the air pressure difference between the "high" and "low" parts of said system adapted to control the air pressure supply and circulation of said system.



PNEUMATIC PATENTS NOVEMBER 17.

1,117,581. HYDRAULIC AIR-PUMP. HERMAN E. KRUECKE, Milwaukee, Wis.

1,117,605. ORGAN-BLOWER. ABRAHAM J. SCHANTZ, Orrville, Ohio.

1,117,644. APPARATUS FOR GRANULATING MOLTEN SLAG. ROBERT DONALDSON, Cleveland, Ohio.

1. In an apparatus for treating liquid slag, a trough including a plurality of stepped inclines, and means for discharging treating streams of fluid over and above said inclines to disintegrate the slag material and accelerate the flow of the latter.

1,117,679. PNEUMATIC TOOL. FITZ JAMES LEWIS, Empire, Canal Zone.

1,117,682. SUPPLEMENTARY AIR - SUPPLYING DEVICE FOR AUTOMOBILE-ENGINES AND THE LIKE. EDWARD M. LYNCH, St. Louis, Mo.

1,117,708. VACUUM AIR-PUMP. PAUL SCHOU, Copenhagen, Denmark.

1,117,911. AIR - COMPRESSOR. JAMES O. ROGERS and WILLIAM H. NEVIN, Denver, Colo.

13,826. (Reissue). PNEUMATIC TOOL. JOHN F. CLEMENT, Philadelphia, Pa.

NOVEMBER 24.

1,118,053. FLUID-PRESSURE MOTOR. MONTAGUE H. ROBERTS, Providence, R. I.

1,118,095. GAS PRODUCER AND COMPRESSOR. EMMANUEL FELIX AUMONT, Paris, France.

1,118,183. BLOWPIPE APPARATUS. WORTHY C. BUCKNAM, Jersey City, N. J.

1,118,189. PNEUMATIC SELF-PLAYING MUSICAL INSTRUMENT. LEWIS B. DOMAN, Elbridge, N. Y.

1,118,200. HUMIDIFIER. JOHN I. HAYNES, St. Louis, Mo.

1. A device for the purpose described that is adapted to be used with an electric fan, said device comprising a tank for holding a bath, an

endless strip of fabric arranged to travel through said bath, and a driving mechanism for moving said strip provided with means that is adapted to be engaged by the blade of the fan.

1,118,249. PNEUMATIC ACTION FOR MUSICAL INSTRUMENTS. EUGENE T. TURNEY, Rock Island, Ill.

1,118,257-8. MILKING-MACHINE. OSCAR ANDERSON, Chicago, Ill.

1,118,261. PNEUMATIC PLAYING ATTACHMENT FOR MUSICAL INSTRUMENTS. ROBERT J. BENNETT, Moline, Ill.

1,118,268. TRACK - DRILLING MACHINE. CHARLES B. COATES, Chicago, Ill.

1,118,294. PNEUMATIC ACTION FOR AUTOMATICALLY-OPERATED MUSICAL INSTRUMENTS. RICHARD A. LEADBETER, Detroit, Mich.

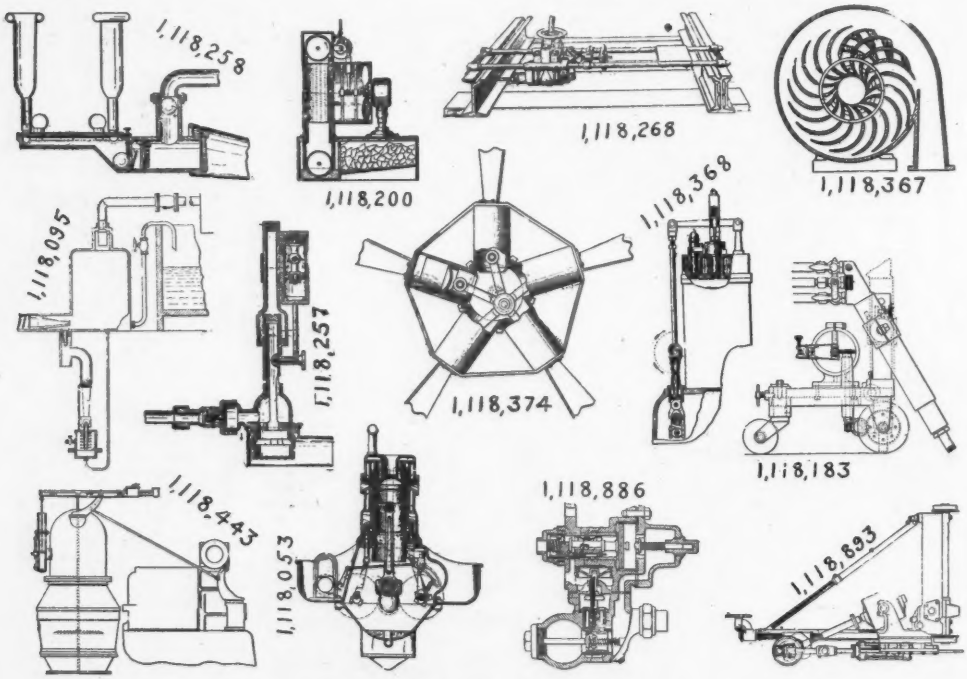
1,118,551. APPARATUS FOR FEEDING TUBES. WILLIAM H. HONISS, Hartford, Conn.

1. The combination, in tube feeding mechanism, of a pneumatic gripping device for holding the tube, a movable pneumatic feeding device for advancing the tube, means for alternately operating said devices to grip and release the tube, and means for moving the said feeding device while it grips the tube.

1,118,552. PROCESS OF PNEUMATIC FEEDING. WILLIAM H. HONISS, Hartford, Conn.

1,118,737. AUTOMATIC COMPRESSION REFRIGERATING APPARATUS. GEORGE P. CARROLL, Bridgeport, Conn.

1,118,786. PNEUMATIC WHEEL. JOSEPH LAUS, JR., Oshkosh, Wis.



PNEUMATIC PATENTS NOVEMBER 24

1,118,297. FLUID-MOTOR AND RETARDING DEVICE THEREFOR. JAMES F. MCELROY, Albany, N. Y.

1,118,367. COMPRESSING GASES OR VAPORS. GUSTAV PAGEL, Berlin, Germany.

1. A centrifugal gas-compressing pump of the water-throwing type, provided with a directing ring or annulus in which no transformation of velocity into pressure occurs, and a surrounding spiral casing which increases in cross-sectional area toward the point of final discharge for effecting such transformation.

1,118,368. AIR STARTING MECHANISM FOR OIL-ENGINES. OTTO F. PERSSON, Erie, Pa.

1,118,374. FLUID - DISPLACING MOTOR. ANTHONY R. SILVERSTON, Milwaukee, Wis.

1. In a device of the character described, the combination with a motor embodying a stationary member and a second member revolving about the first said member, of a plurality of propeller blades mounted on said revolving member, and means for varying the pitch of said blades on said revolving member.

1,118,443. MEANS FOR CHANGING THE OUTPUT OF CENTRIFUGAL COMPRESSORS. RICHARD H. RICE, West Lynn, Mass.

1,118,886. AIR-BRAKE APPARATUS. JOHN W. BINGLEY, Watertown, N. Y.

1. The combination of a triple valve of an automatic air brake apparatus having an emergency valve controlling a vent passage from the train pipe and itself controlled by the triple valve piston and valves actuated thereby; with a controlling valve for the train pipe vent passage governed by variations in train pipe pressure independently of the triple valve piston and parts actuated thereby substantially as and for the purpose described.

1,118,893. TOOL-ACTUATING MECHANISM. ALBERT BALL and HENRY H. MERCER, Claremont, N. H.

1. Tool actuating mechanism comprising a main frame, a standard rising therefrom, a frame mounted upon said standard and vertically adjustable thereon, tool holding means mounted for reciprocation upon said frame and having a fluid receiving chamber, a working cylinder operatively connected to said tool holding means and in fluid connection with said receiving chamber, a piston mounted in said cylinder, a motor mounted independently of said frame and driving connections between said piston and said motor.

The Catskill Water Supply of New York City

By Lazarus White, C. E.

This book. just issued, is written by a division engineer of the Board of Water Supply, who had free access to all records and data. In preparation of the book, the author had the cooperation of many of his colleagues on the aqueduct work. It has all the authority and reliability of an official report without any of its prolixity. It speaks of each contract in detail and describes the various special engineering problems encountered and the methods of their solution.

The book is a handsome octavo of nearly 800 pages with 238 illustrations, many of them full page and all contributing to the interest and value of the work.

PRICE $6.00 (£ 1-5-6) net **Postage Prepaid**

---FOR SALE BY---

COMPRESSED AIR MAGAZINE COMPANY

11 Broadway, NEW YORK, N. Y.

You'll Get Better Service at Less Operating Cost

with ***National***

High Efficiency

Air Compressors

BETTER: Because our years of experience and knowledge of requirements has enabled us to embody many ***new, important and distinctive features*** in their design and construction. Our large and complete line comprises many types and sizes from which to select one to fit your particular conditions. They are illustrated and described in catalogues—S 400 and S 401 Write our nearest Sales Office for copies today.

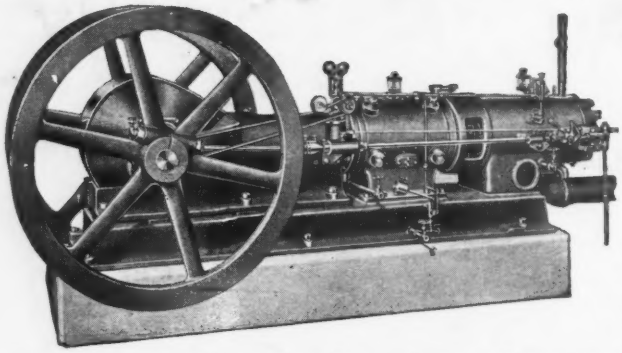
National Brake & Electric Co.

Works at Milwaukee, Wis.

SALES OFFICES

New York, No. 165 Broadway St. Louis, No. 318 Security Bldg. Chicago, No. 827 Railway Exchange
Pittsburgh, Pa., 9th and Penn Ave. London, England, 14 Great Smith St.

Absolute Independence



OF STEAM, ELECTRICITY, BELT OR GEARING.

"Chicago Pneumatic" Class N-SO Fuel Oil Compressor

A Unit System Compressed Air Plant consisting of Four Class N-SO "Chicago Pneumatic" Fuel Oil Driven Compressors will furnish 1200 cubic feet of free air per minute piston displacement delivered under 100 pounds pressure at a total cost for power of 72 cents per hour.

Compare this with your Air Power Cost Records and determine how long it will take this plant to pay for itself. The Unit System adjusts supply to demand at sustained maximum efficiency It automatically responds to any increase or decrease in Air Consumption.

Four Sizes: 70 to 300 cubic feet capacity. Also truck mounted for portable service. Ask for Bulletins. Prices and information on request. Address Dept. H.

1027 Fisher Bldg. Chicago

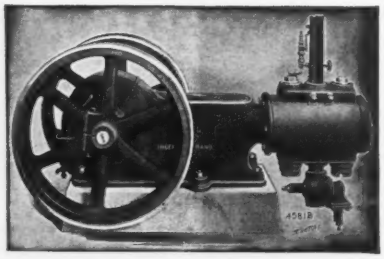
Chicago Pneumatic Tool Co.

AGENCIES AND BRANCHES EVERYWHERE

50 Church Street New York

JEWETT

24-26 Stone St., New York



Specialists in

WASH AND LINE DRAWINGS

Photo Retouching of MECHANICAL SUBJECTS

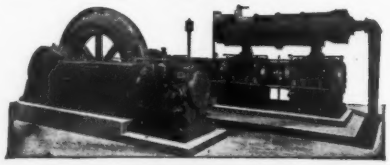
HALF TONES

ZINC ETCHINGS

THE BURY 3-CYLINDER VARIABLE VOLUME AIR COMPRESSOR

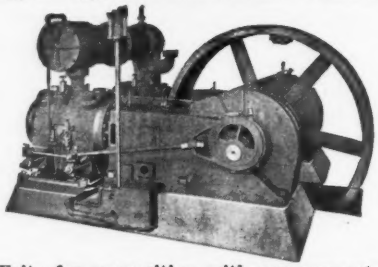
PATENTED

Automatically Prevents Waste Compression. Saves Power.



Making new World's Record. We can save you money. All types. All sizes. To meet all engineering requirements.

Duplex Type Variable Volume. Patented.



Write for proposition with our guarantee.

BURY COMPRESSOR CO., ERIE, PA.

Tell the Advertiser You Saw His Ad. in COMPRESSED AIR MAGAZINE.